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Del Gaone et al.

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[45] **Date of Patent: *Sep. 10, 1996**

[54] **SPRAY GUN ASSEMBLY AND SYSTEM FOR FLUENT MATERIALS**

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[73] Assignee: **Binks Manufacturing Company**, Franklin Park, Ill.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,370,315.

[21] Appl. No.: **323,154**

[22] Filed: **Oct. 14, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 138,473, Oct. 15, 1993, Pat. No. 5,370,315.

[51] **Int. Cl.**[6] **B05B 7/02**; B05B 1/28

[52] **U.S. Cl.** **239/527**; 239/290; 239/124; 239/583

[58] **Field of Search** 239/124, 125, 239/526, 527, 583, 290, 528, 413–415, 407, 429, 433; 222/380; 137/872, 625.48

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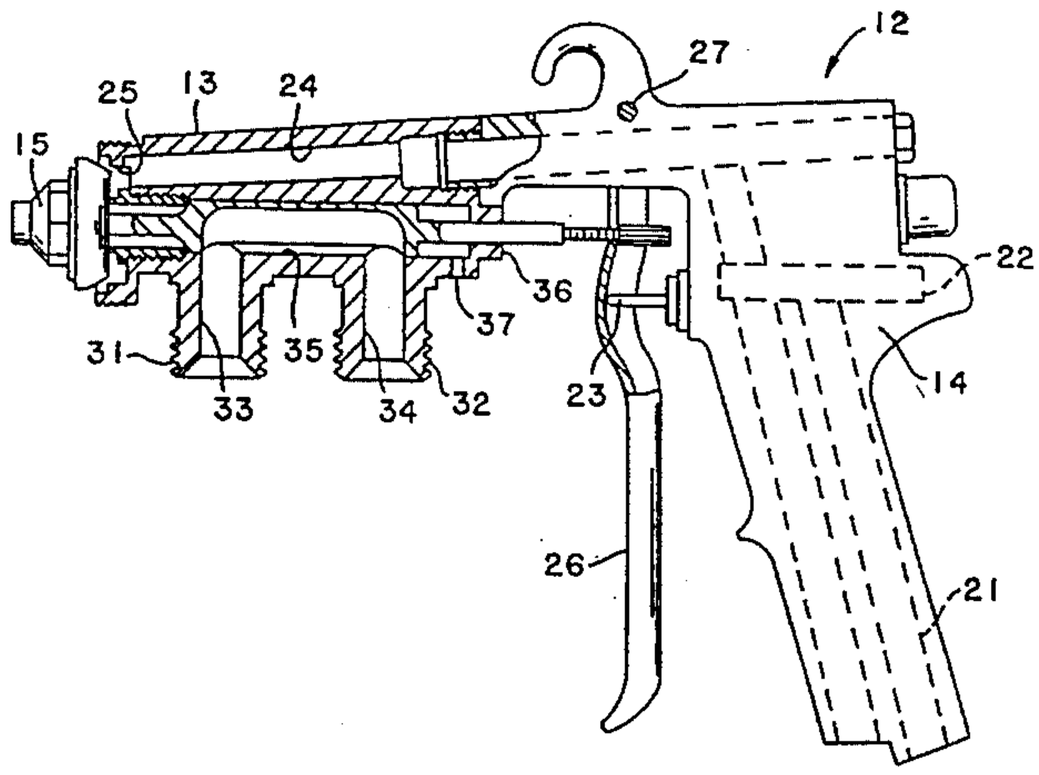
Primary Examiner—Andres Kashnikow
Assistant Examiner—Lesley D. Morris
Attorney, Agent, or Firm—Dann, Dorfman, Herrell and Skillman, P.C.; Henry H. Skillman

[57] **ABSTRACT**

A spray gun for spraying fluent materials comprising a valve chamber, a nozzle connected to the chamber at one end thereof, inlet and outlet ports communicating with the valve chamber, and a valve element having a hollow interior displaceable in the chamber between closed and open positions. The valve element is operable in the closed position to extend between the inlet and the outlet ports to allow flow of material through the inlet into the hollow interior of the valve element and out through the outlet. The valve element in the open position is operable to split the flow through the inlet into: a first partial flow through the hollow interior of the valve element and out of the hollow interior and the valve chamber through the outlet; and a second partial flow through the spray nozzle, whereby the flow through the outlet is uninterrupted when the inlet is receiving the material under pressure.

52 Claims, 10 Drawing Sheets



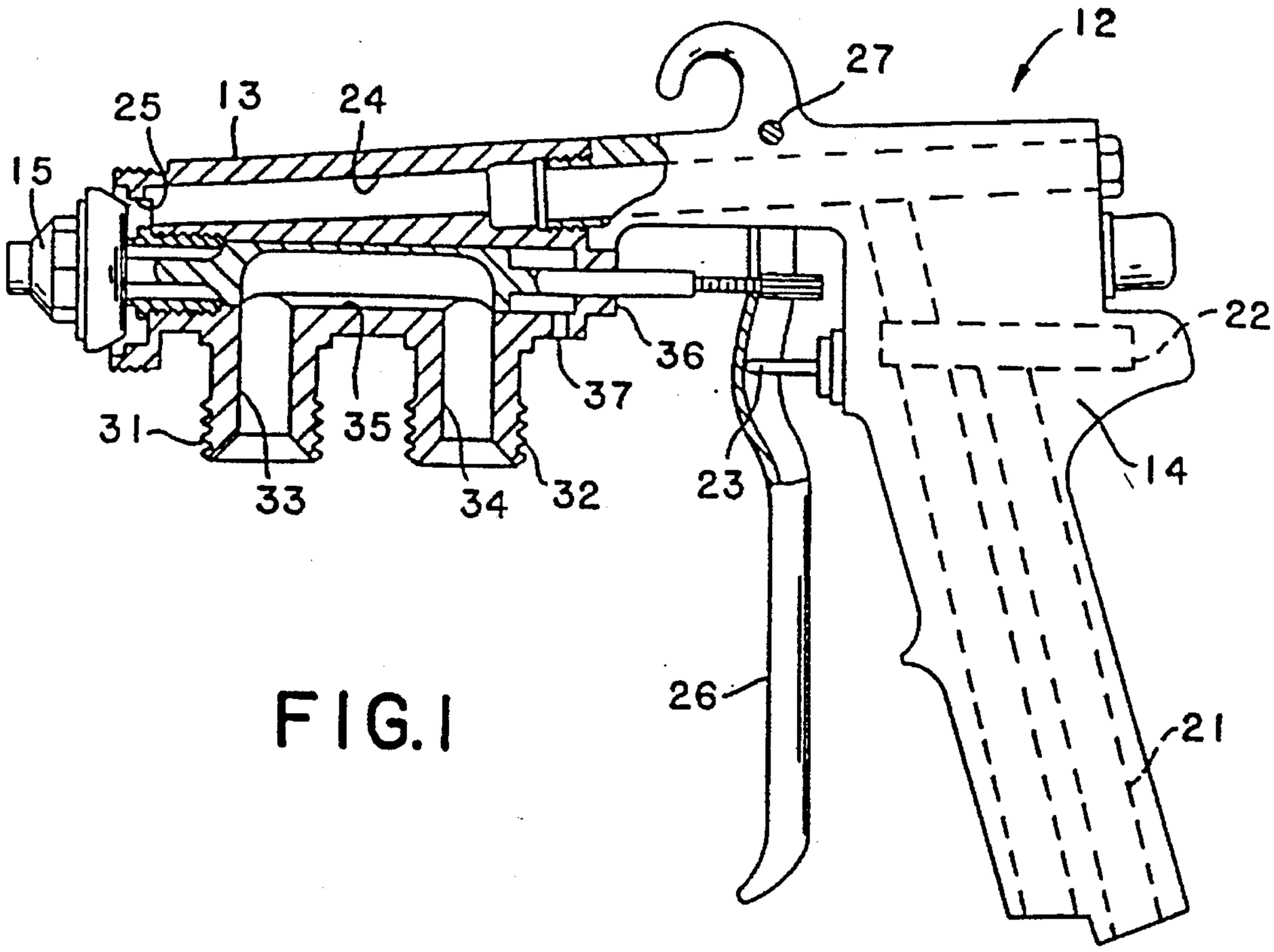


FIG.1

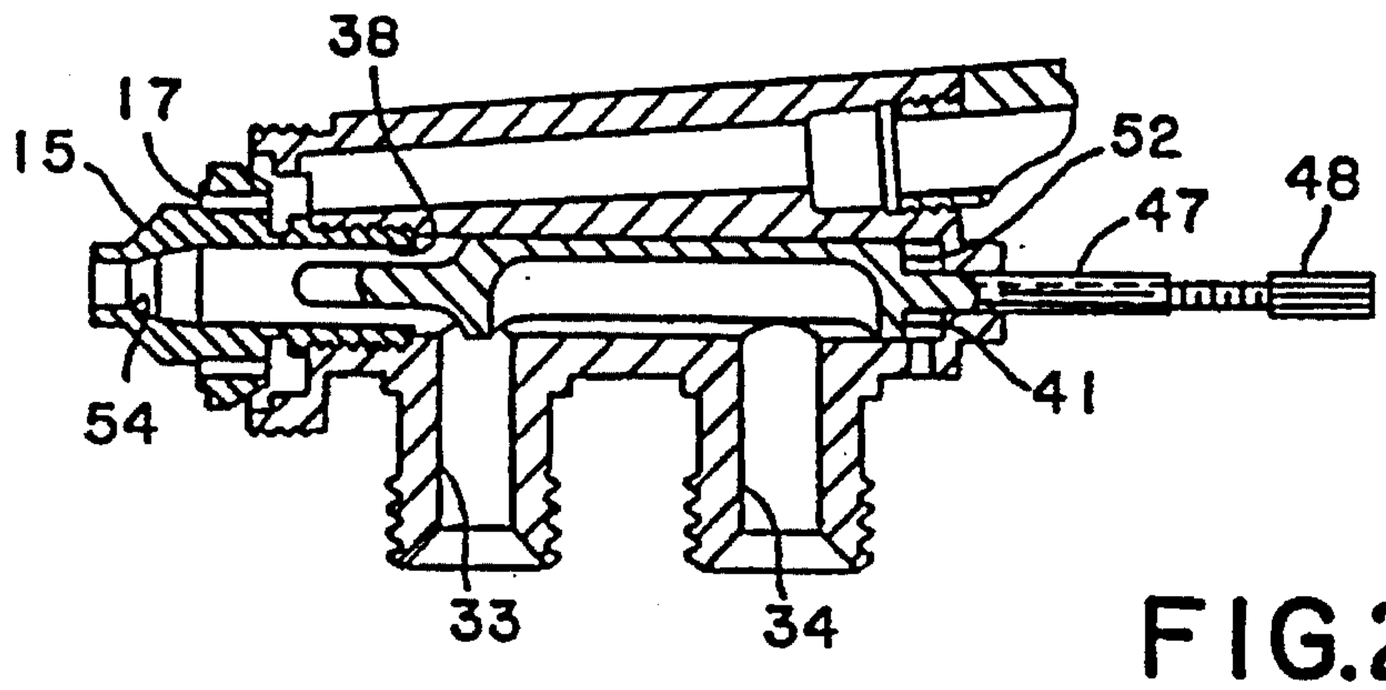


FIG.2

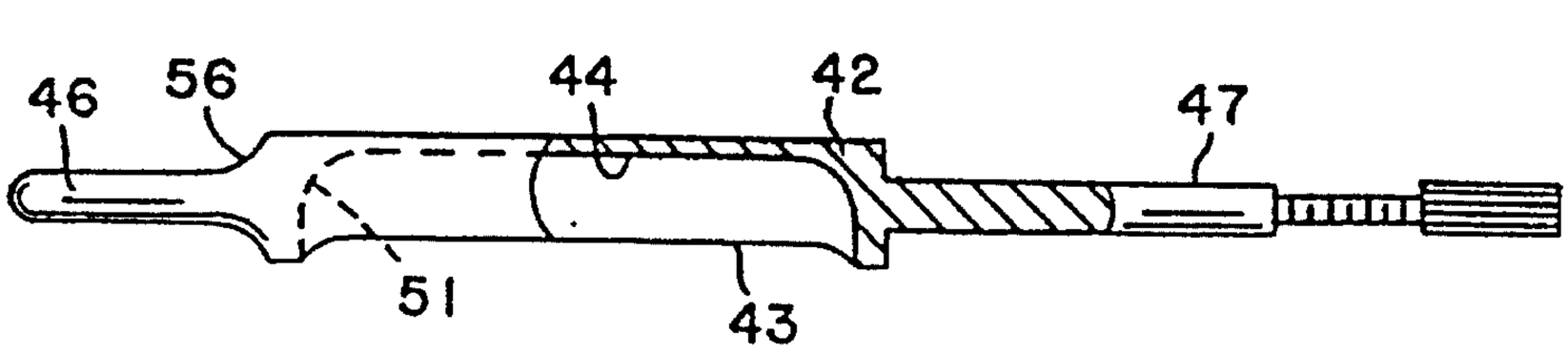


FIG.3

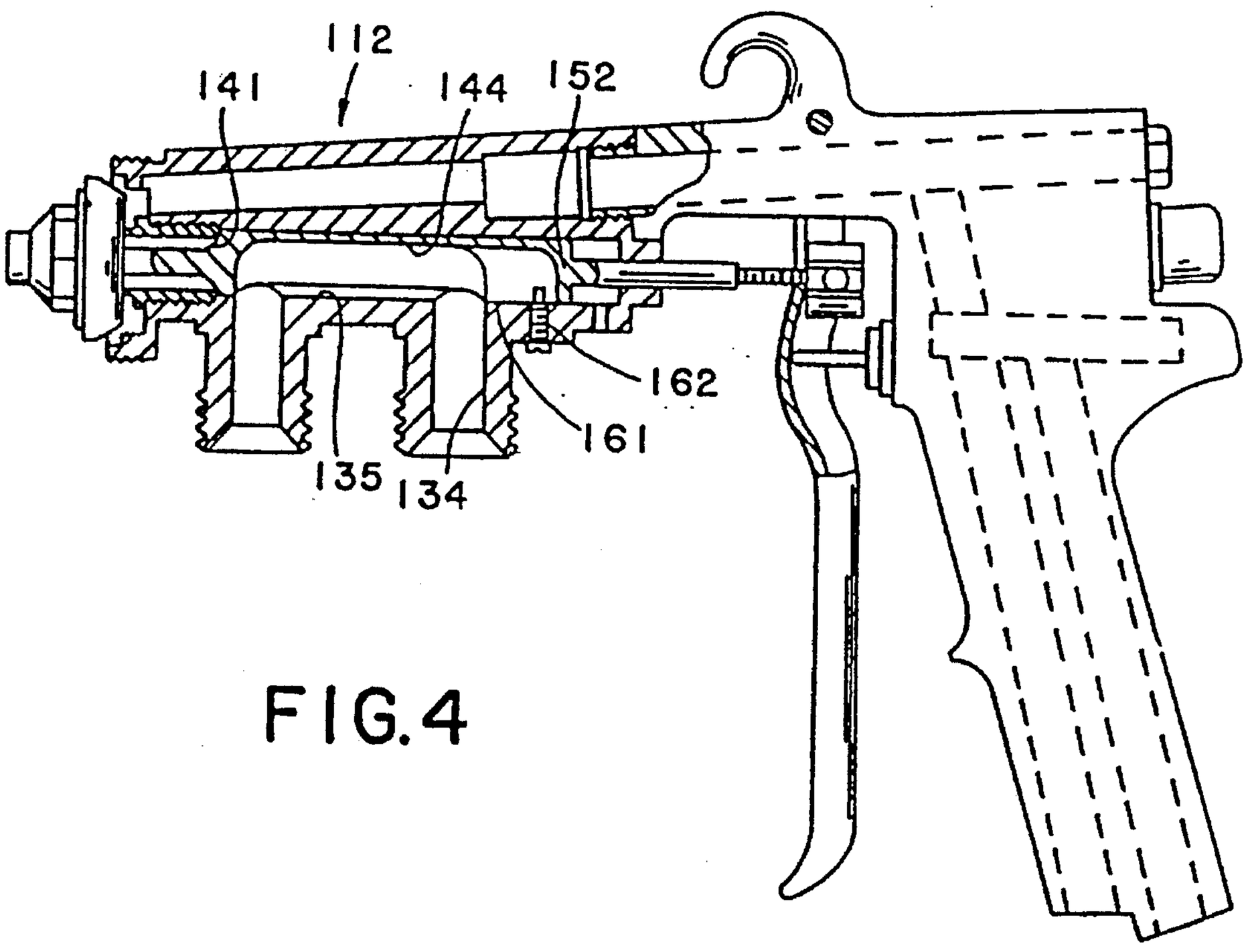


FIG.4

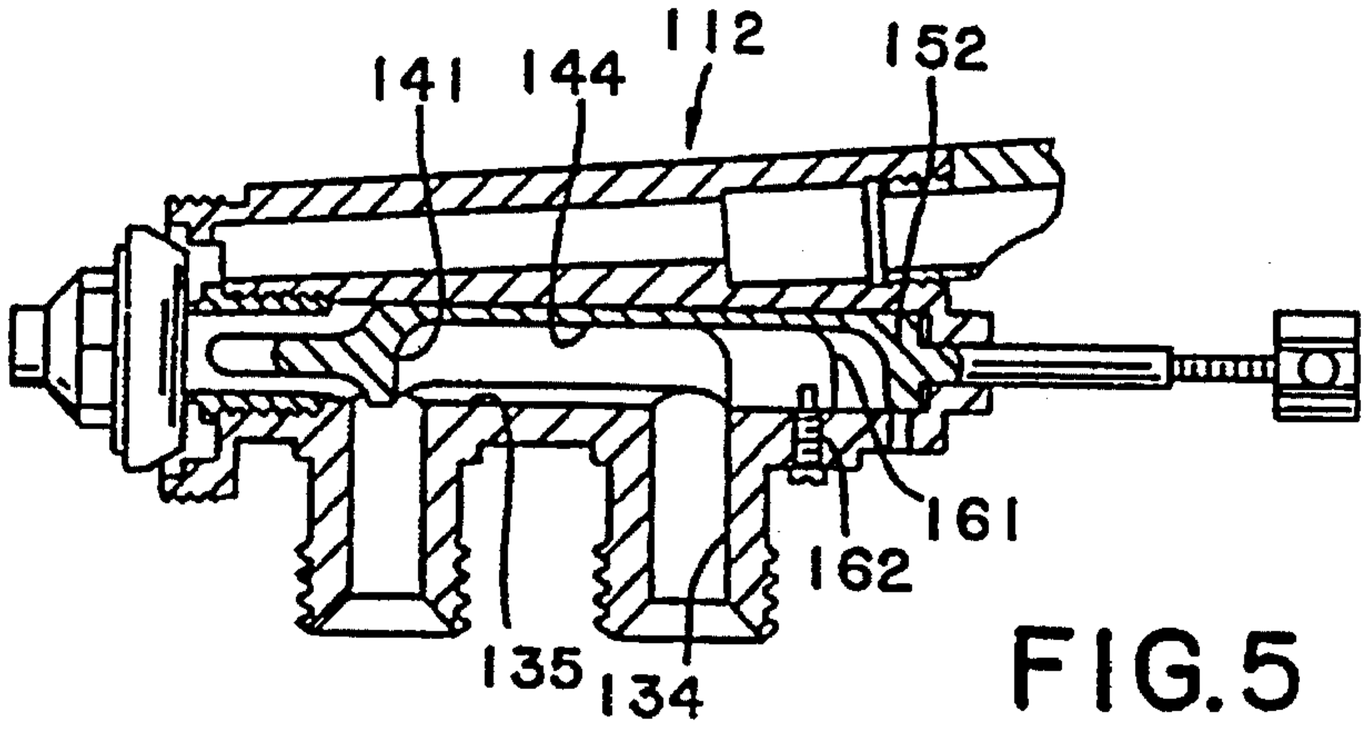


FIG.5

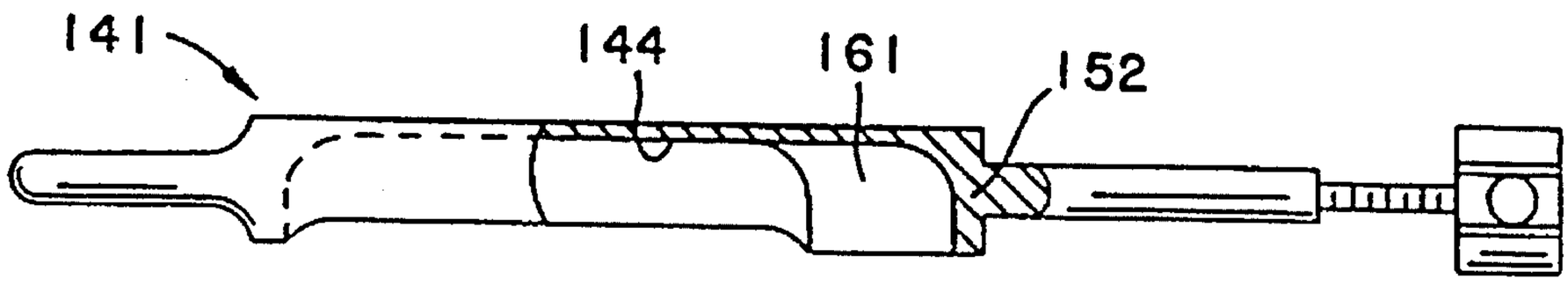


FIG.6

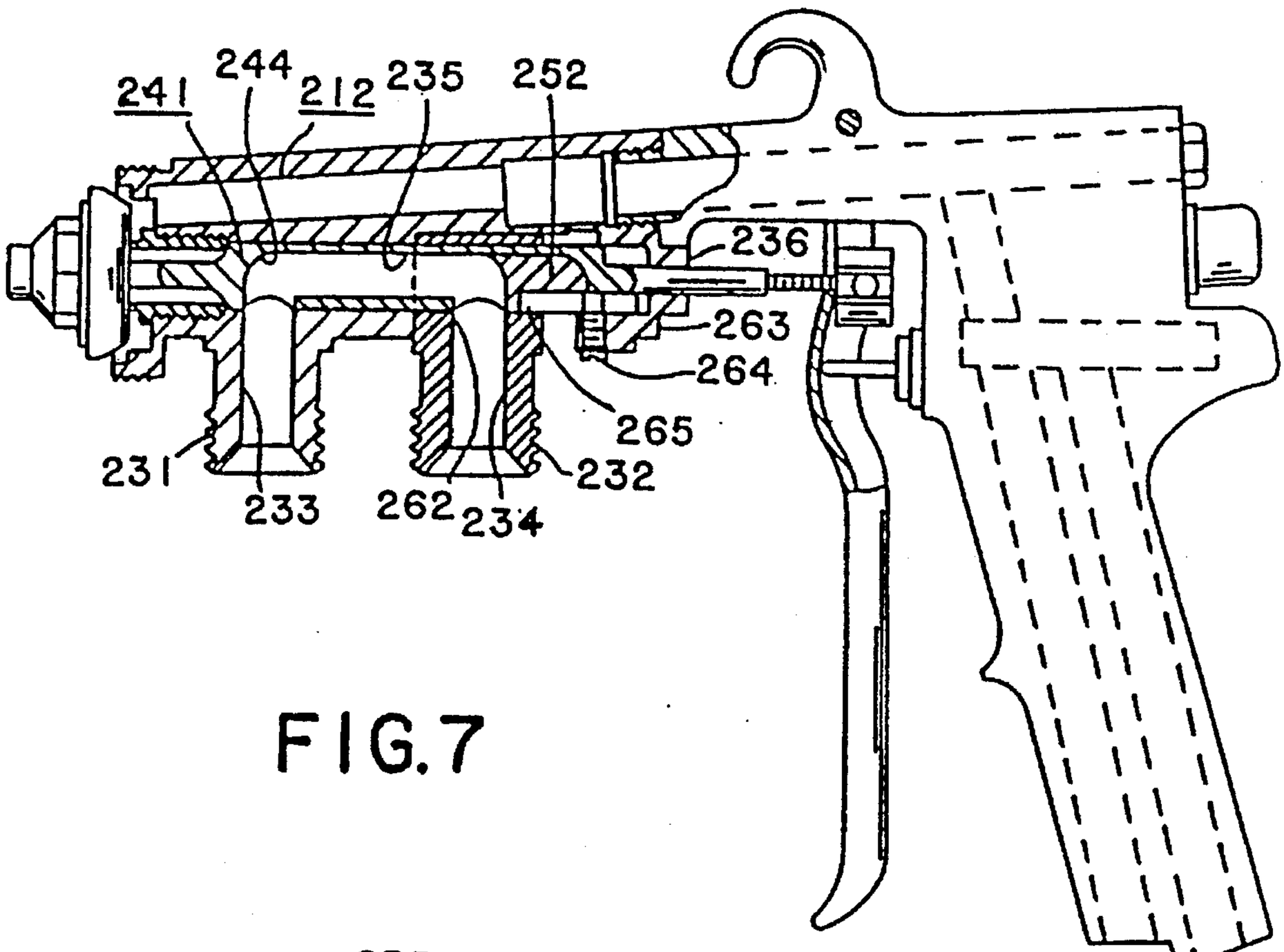


FIG.7

FIG.8

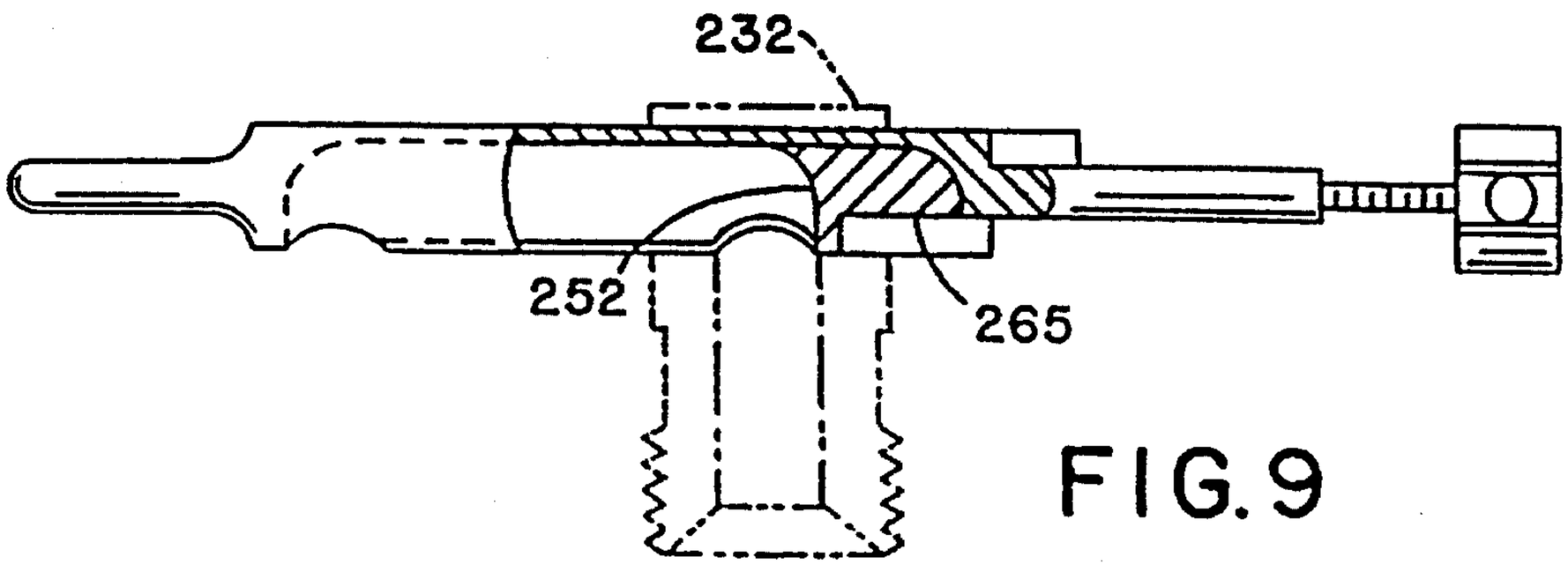


FIG.9

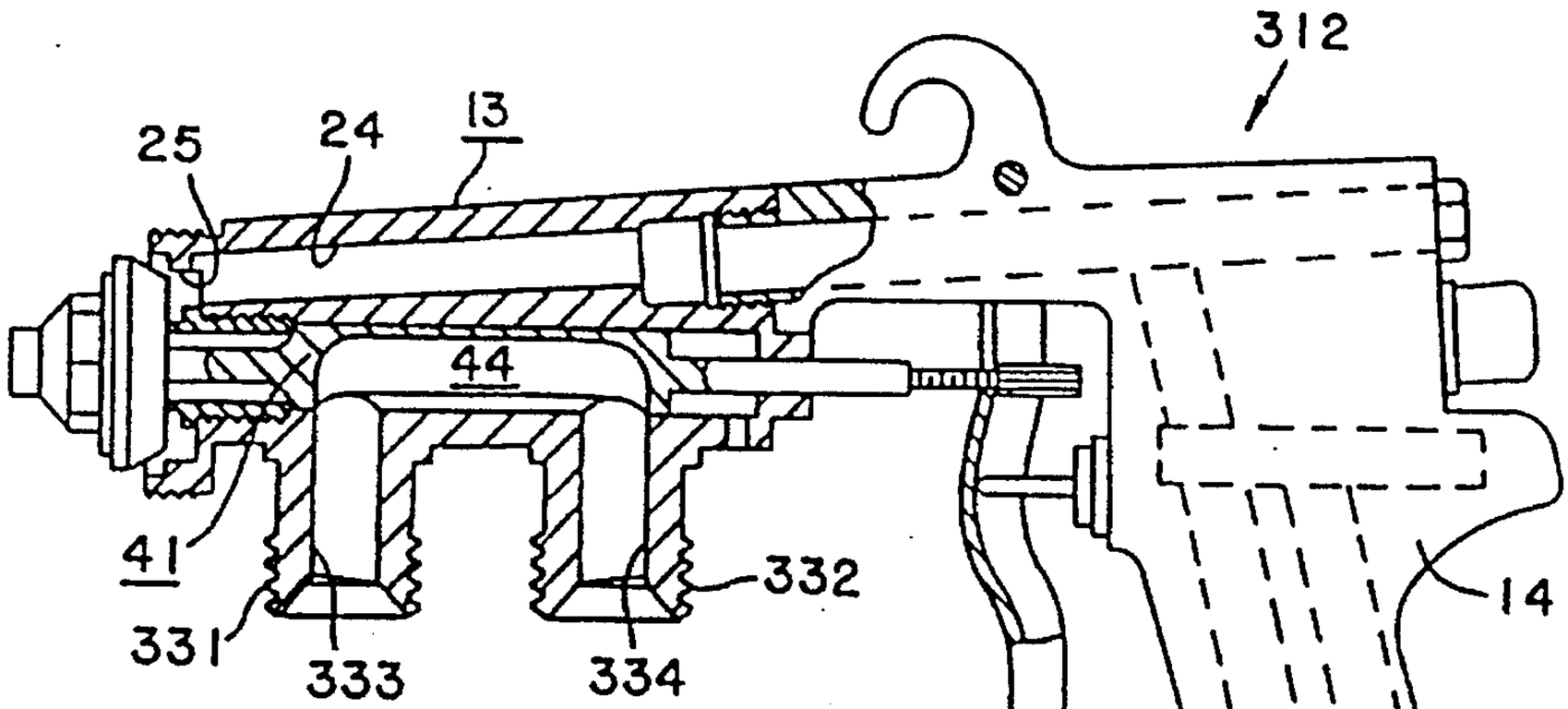


FIG. 10

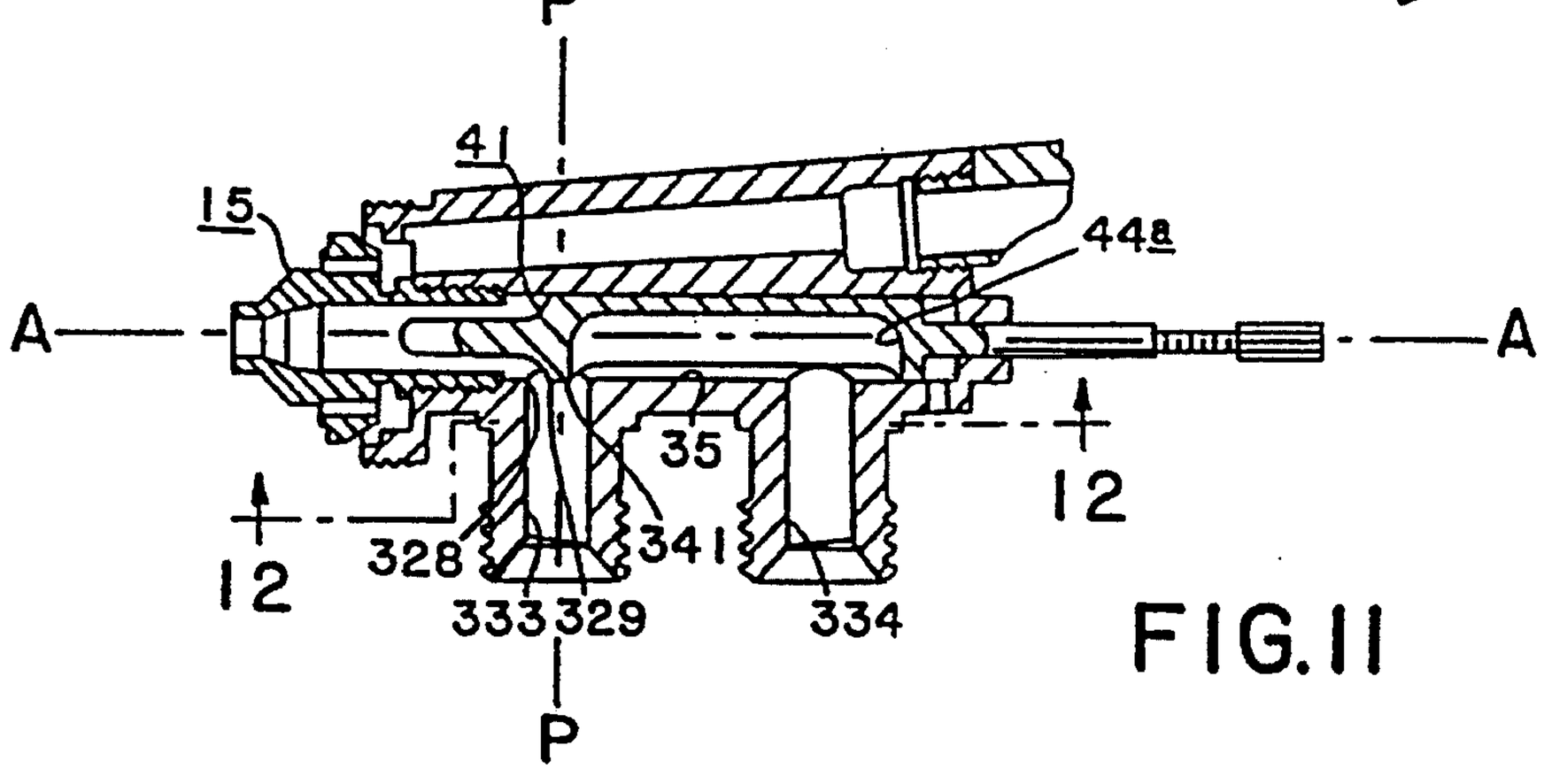


FIG. 11

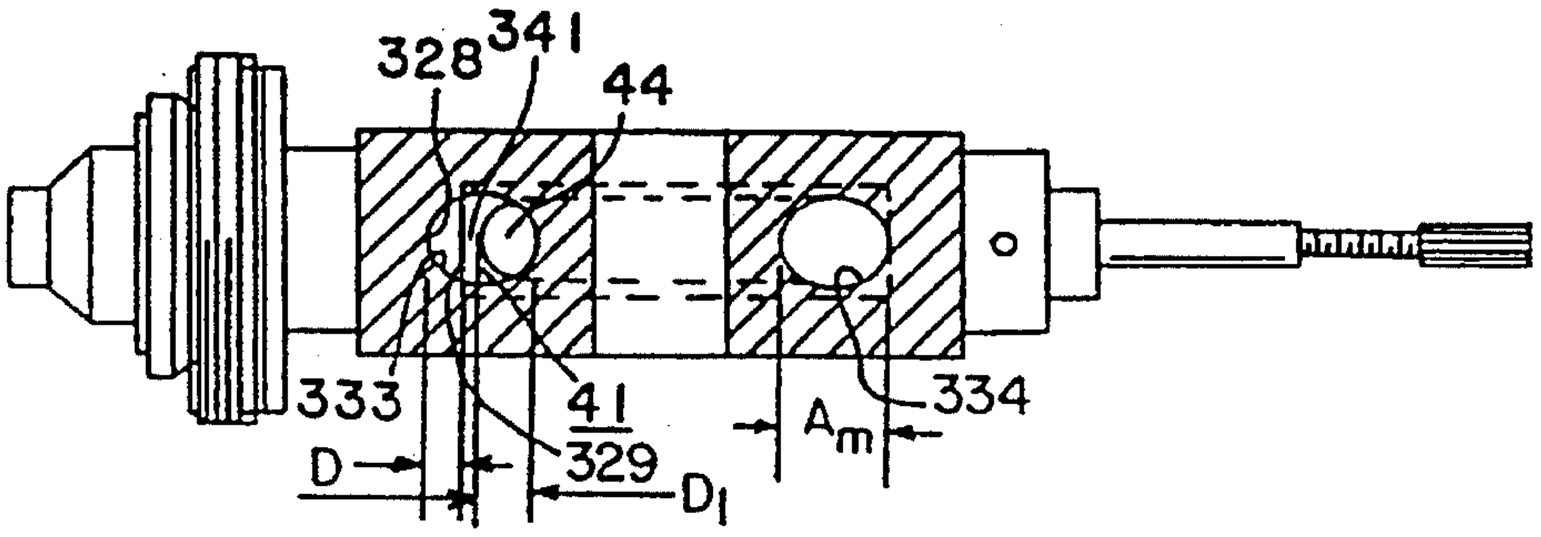


FIG. 12

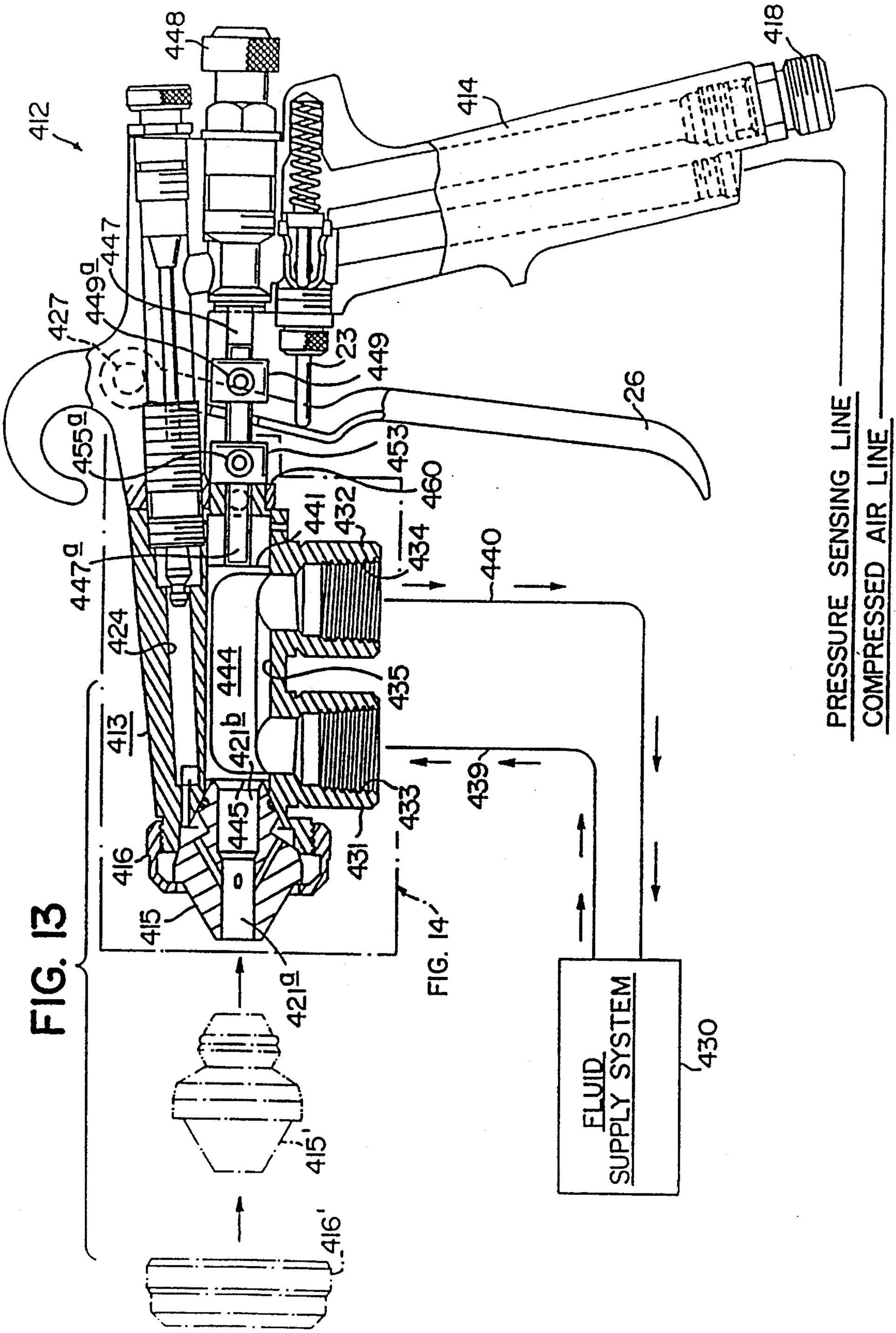

412
448
418
414
427
447a
449a
23
449
26
455a
453
460
441
432
434
440
447a
424
444
435
413
421b
439
445
433
416
431
415
421a
FIG. 14
FLUID SUPPLY SYSTEM
430
415'
416'
PRESSURE SENSING LINE
COMPRESSED AIR LINE

FIG. 13

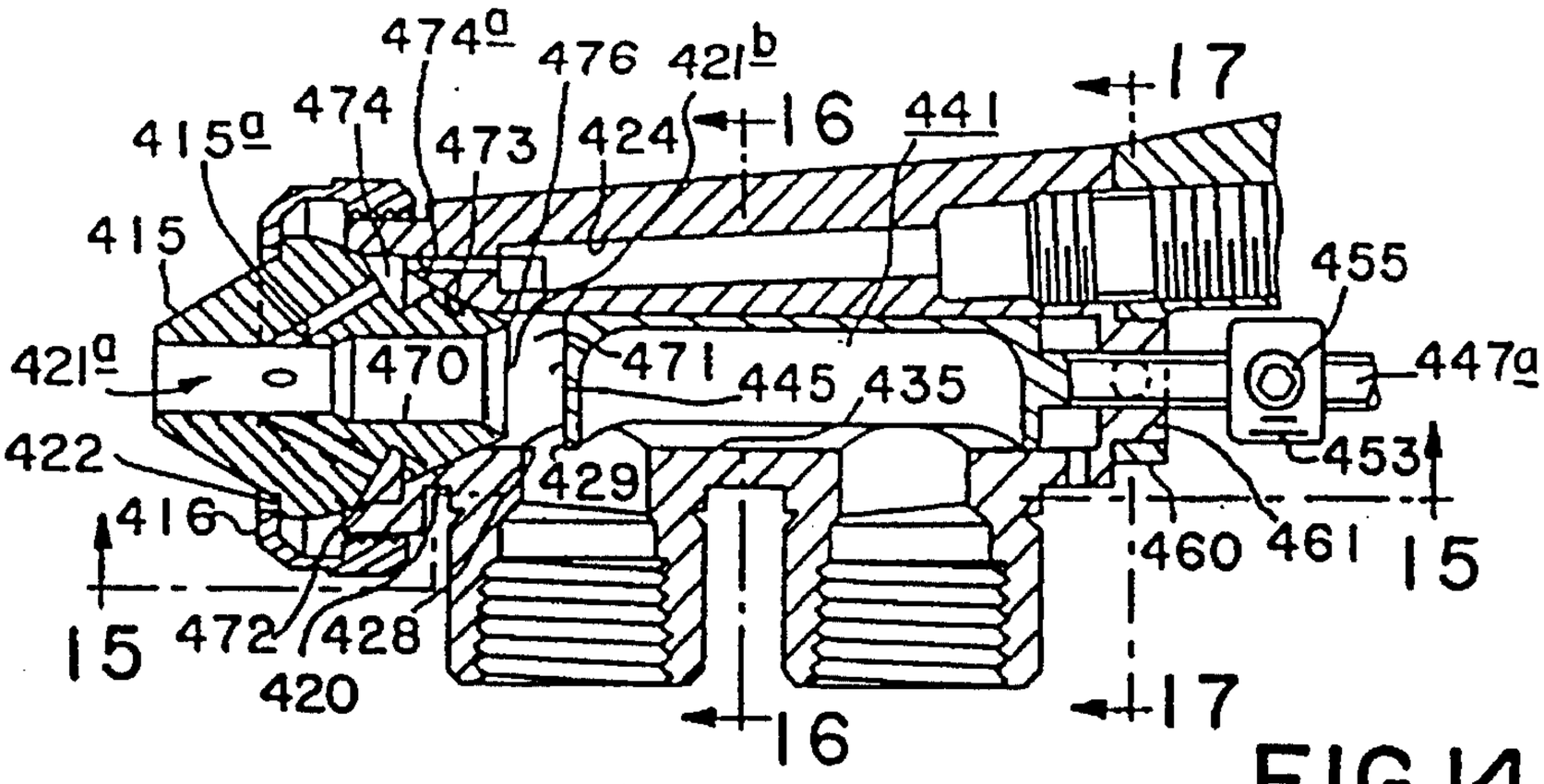


FIG.14

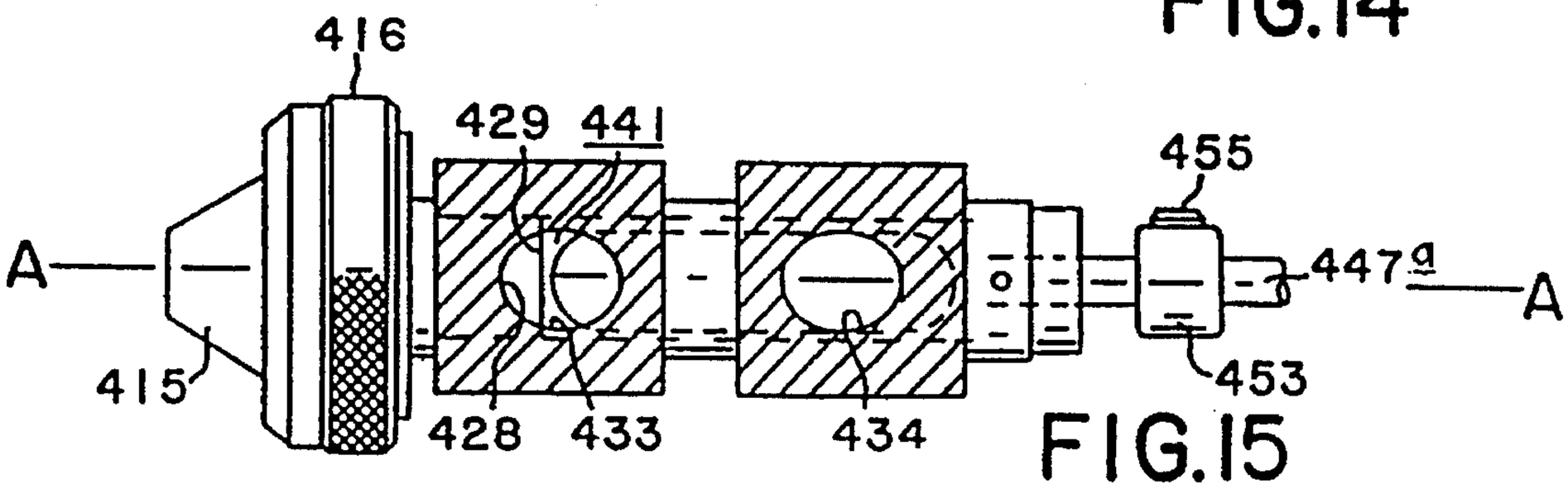


FIG.15

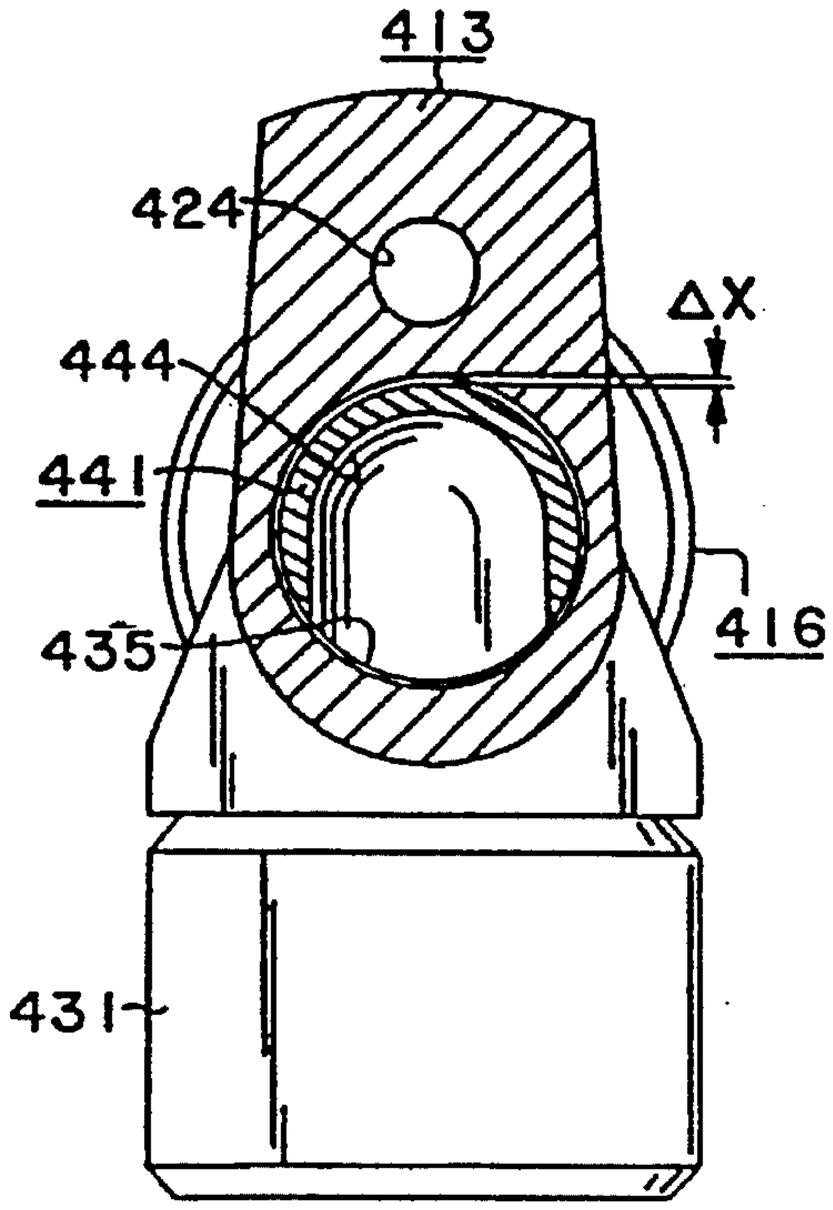


FIG.16

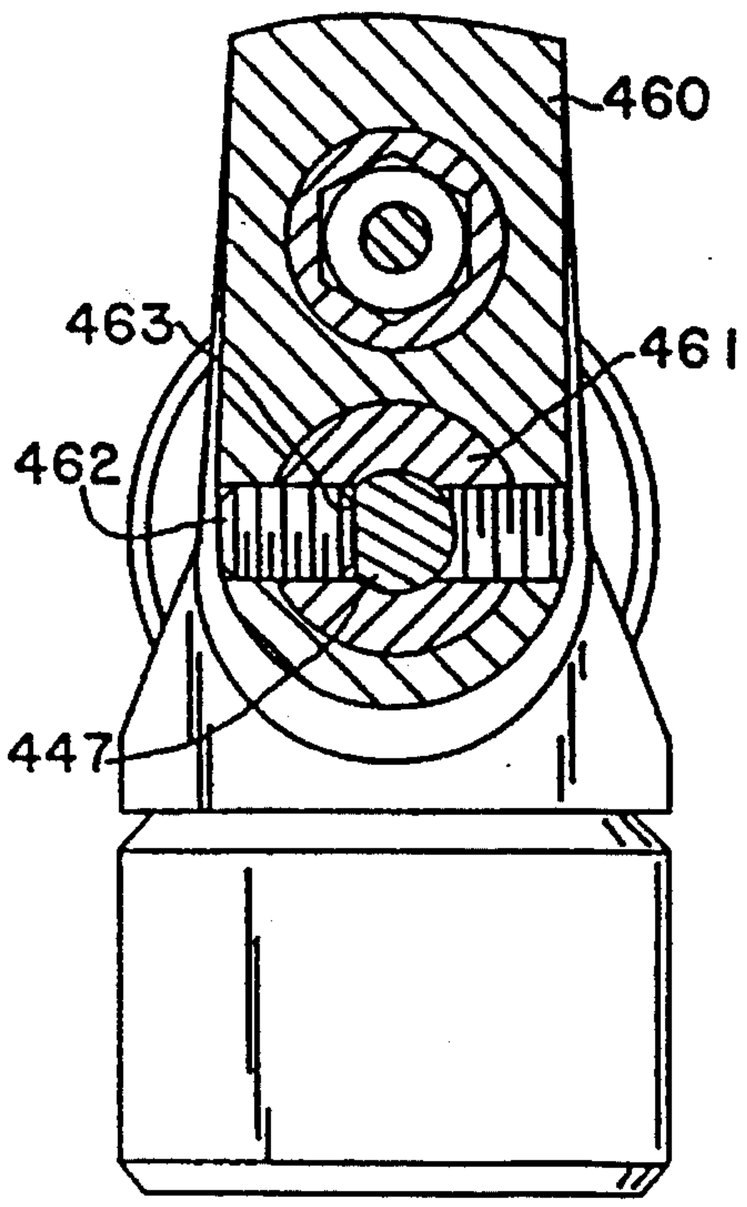


FIG.17

FIG. 18A

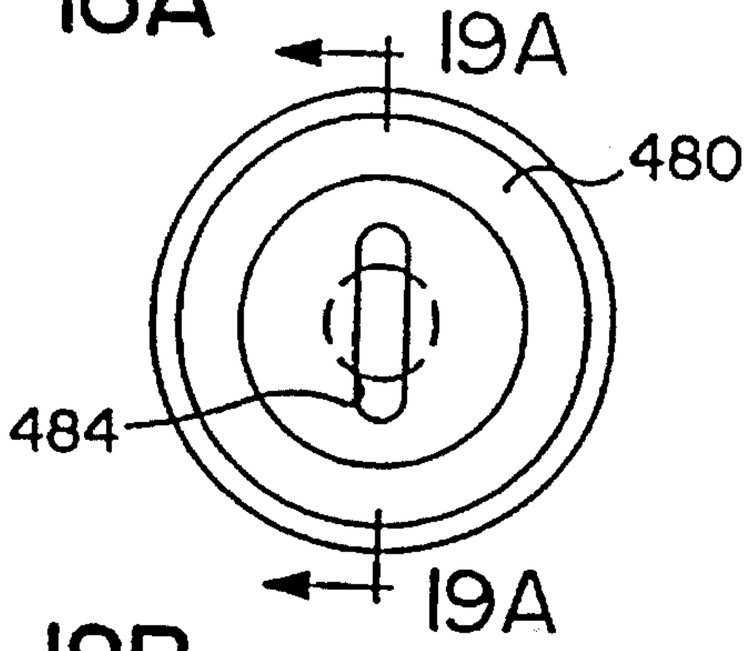


FIG. 18B

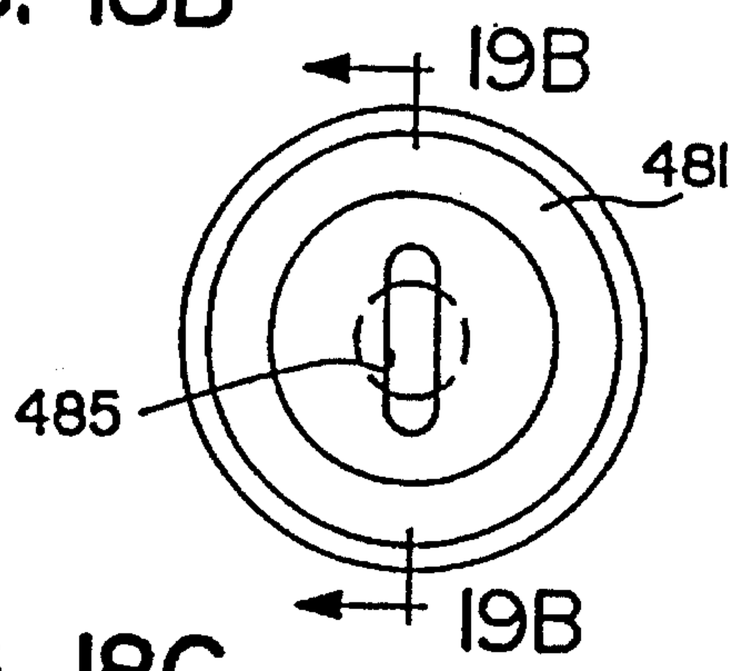


FIG. 18C

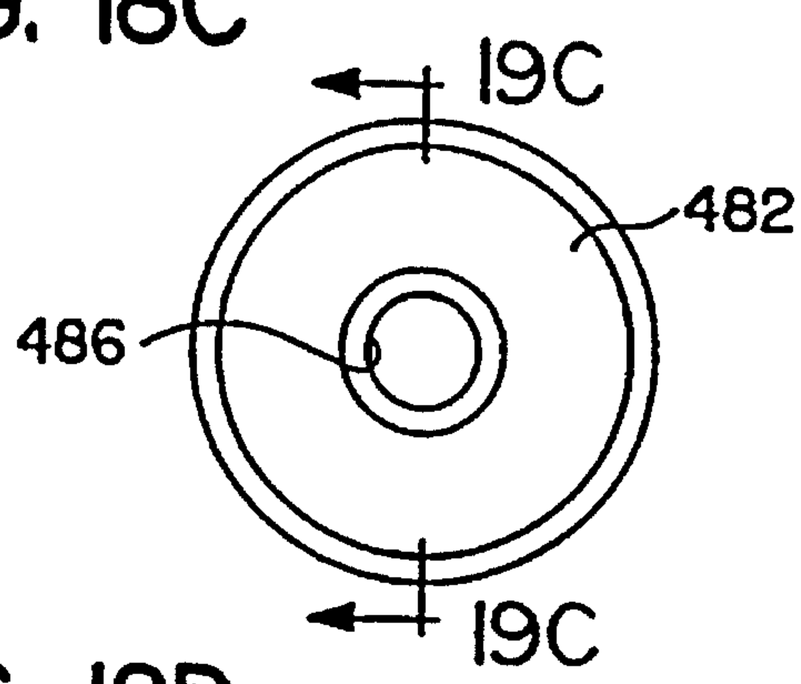


FIG. 18D

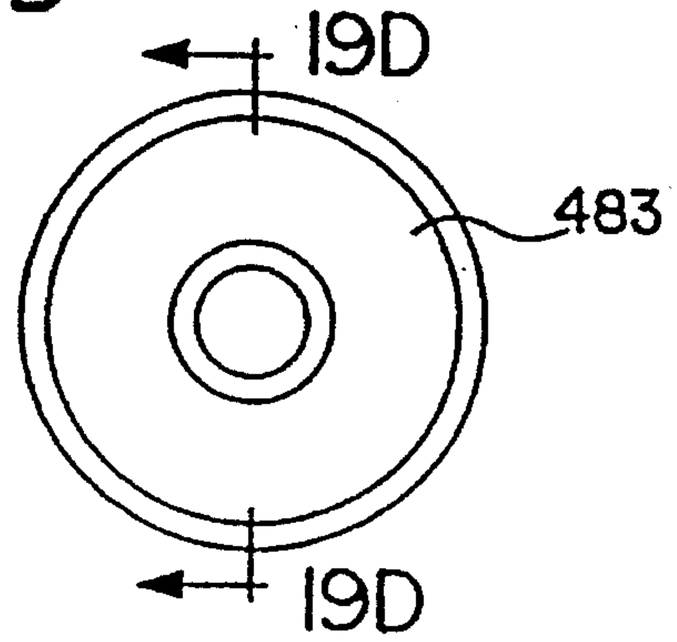


FIG. 19A

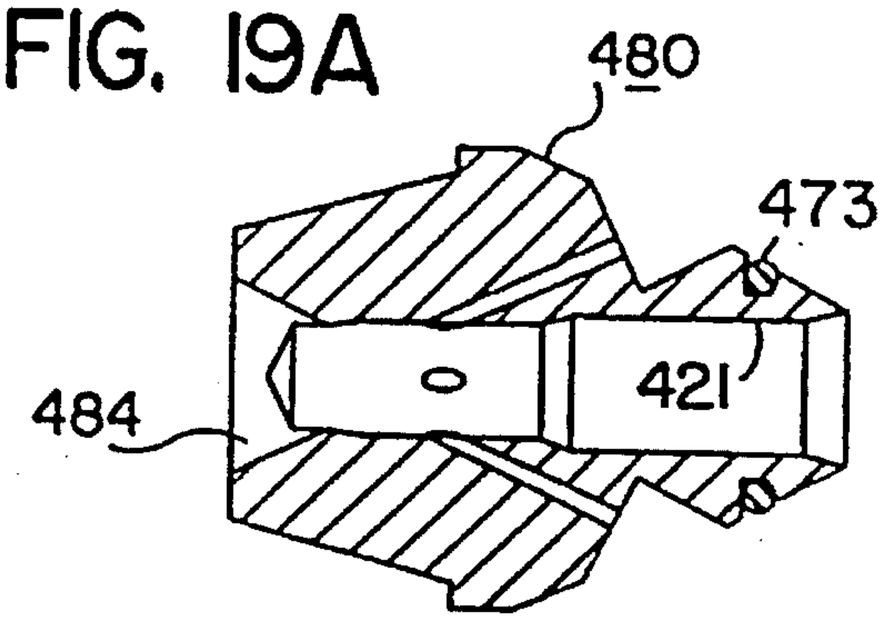


FIG. 19B

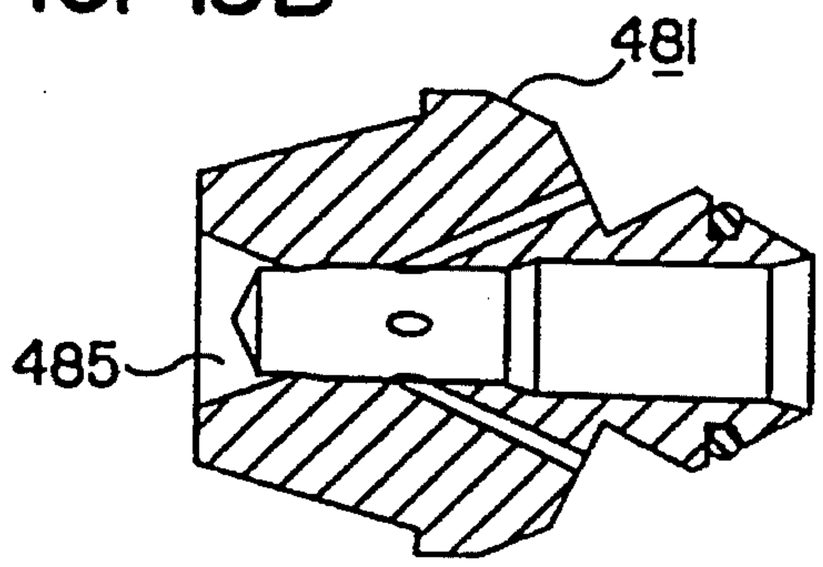


FIG. 19C

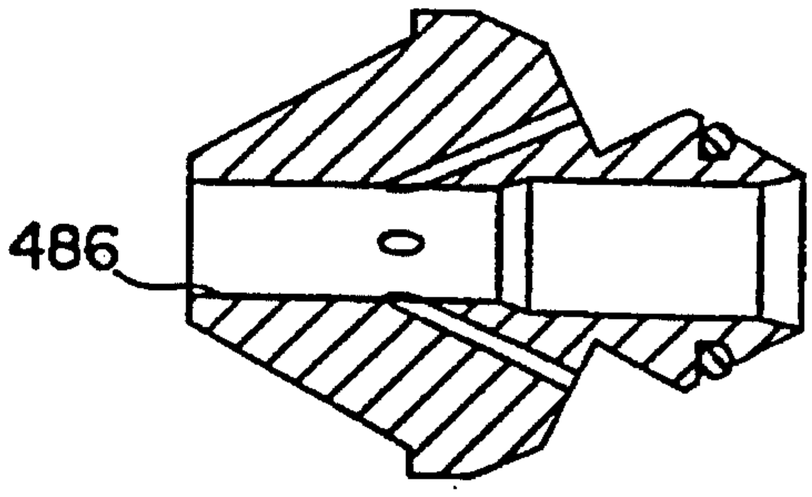
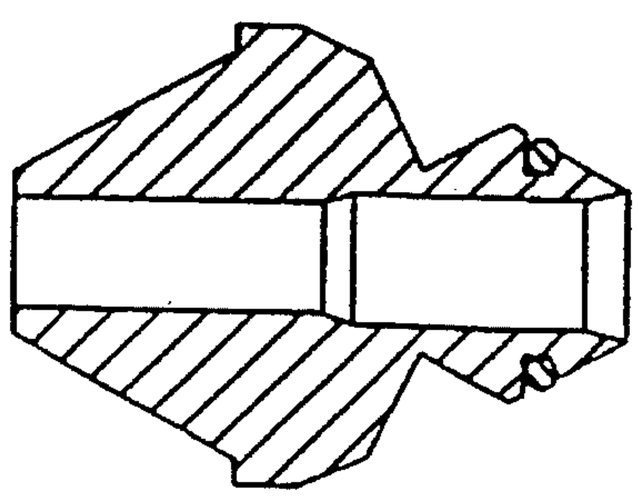


FIG. 19D



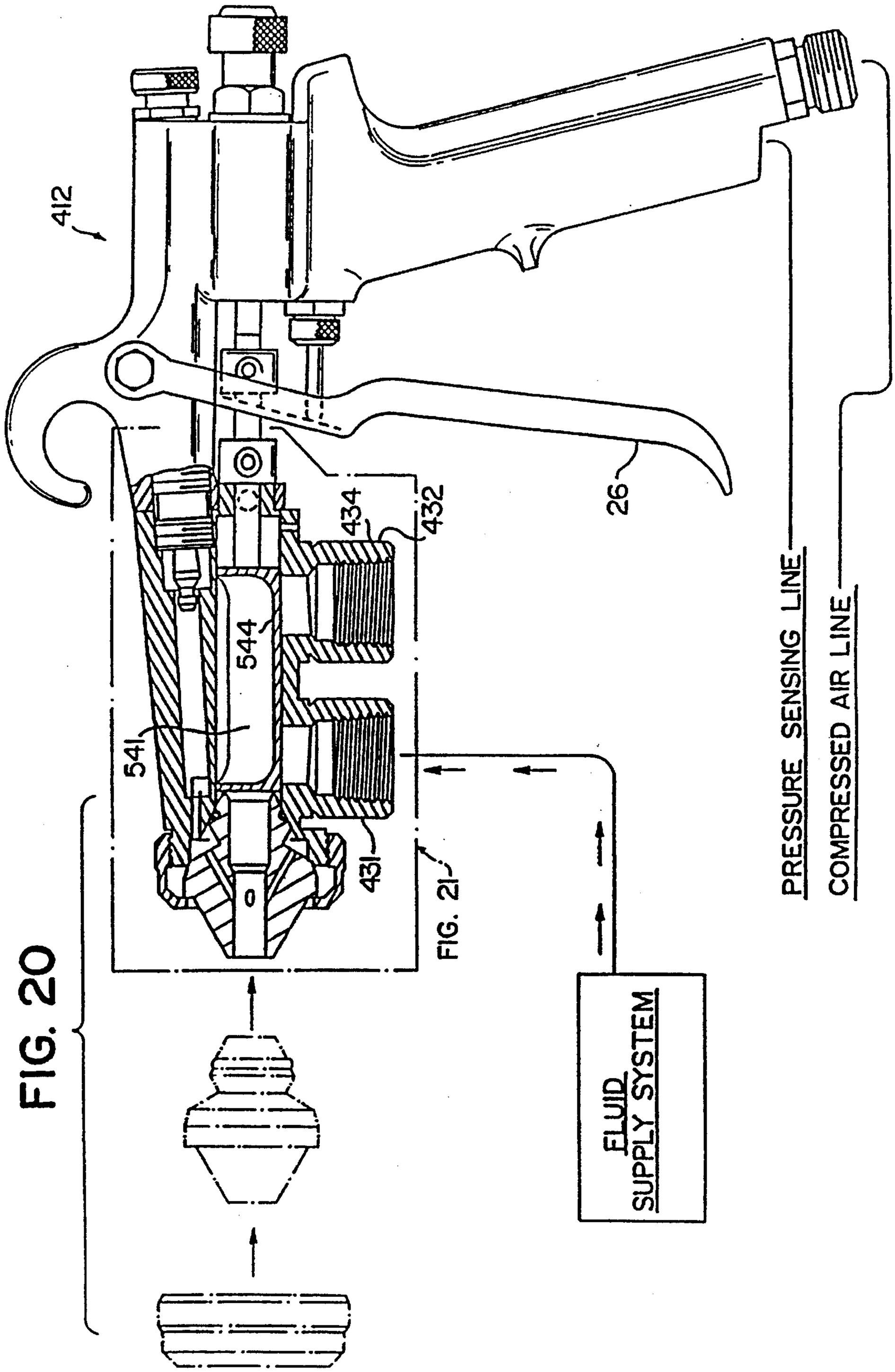

412
26
434
432
544
541
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FIG. 21
FLUID SUPPLY SYSTEM
PRESSURE SENSING LINE
COMPRESSED AIR LINE

FIG. 20

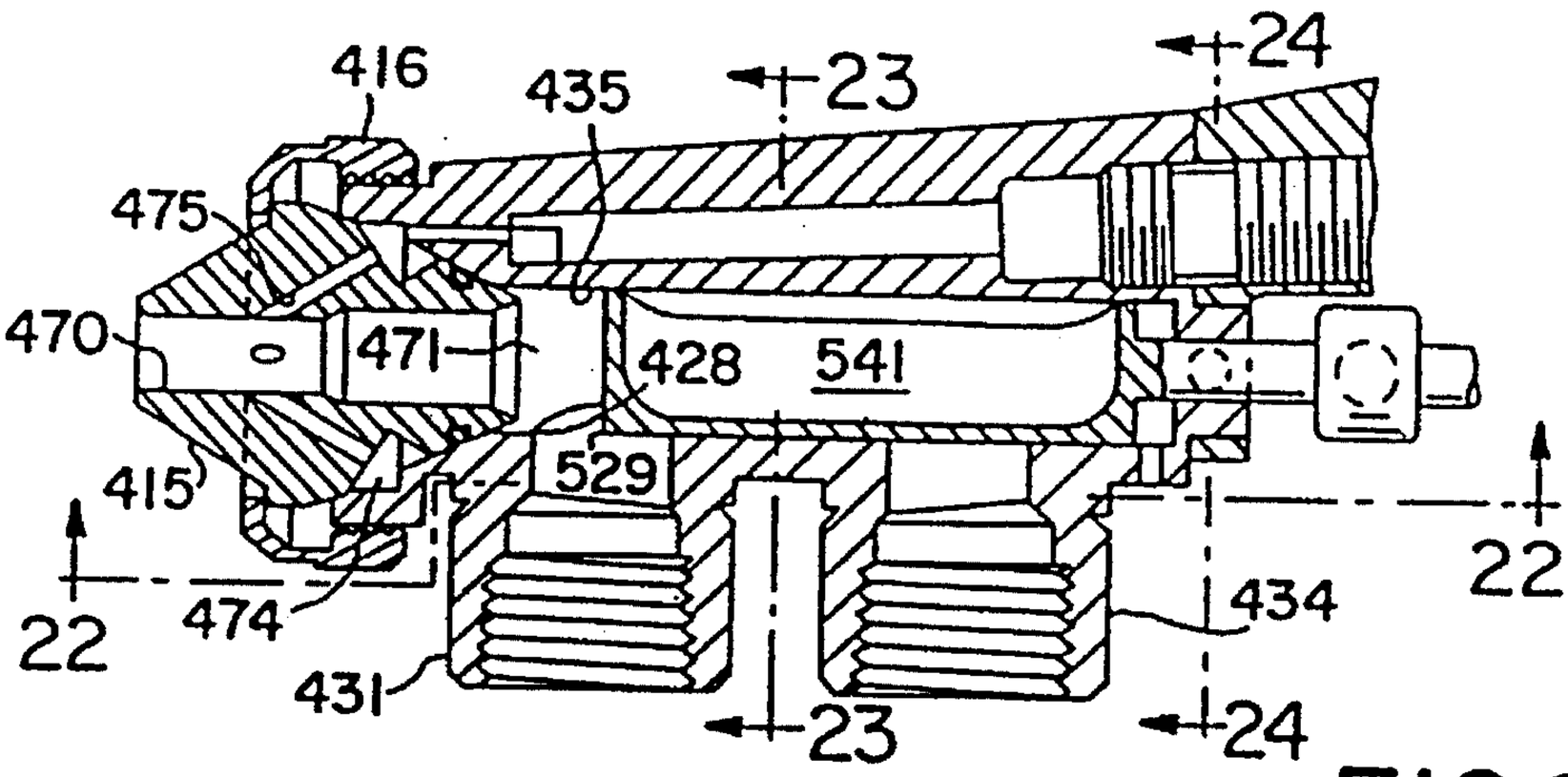


FIG.21

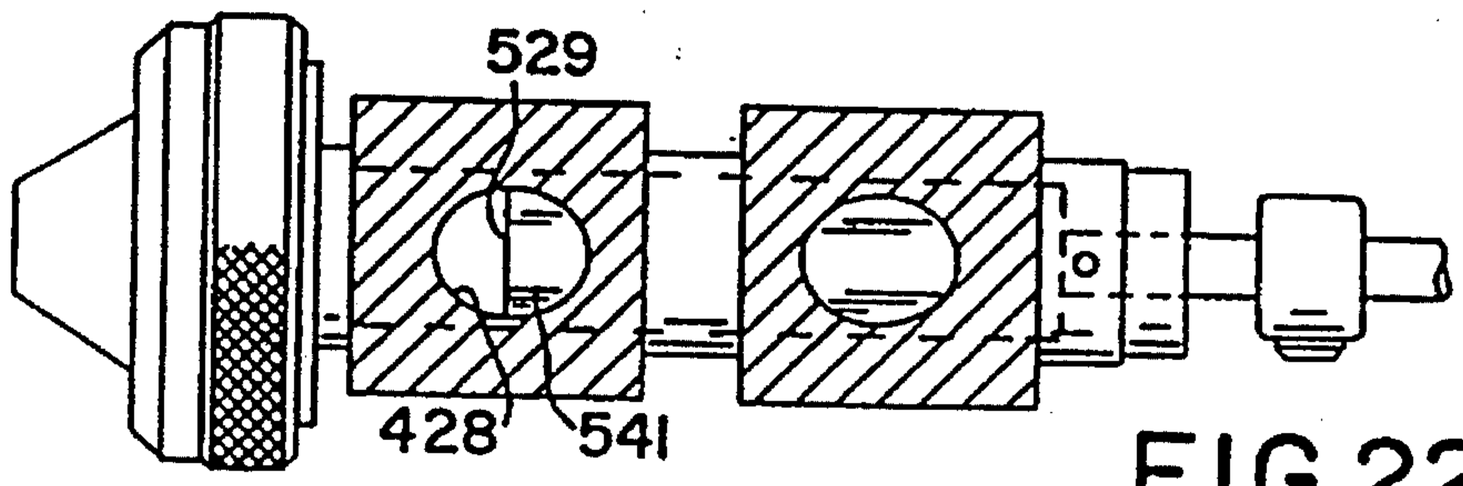


FIG.22

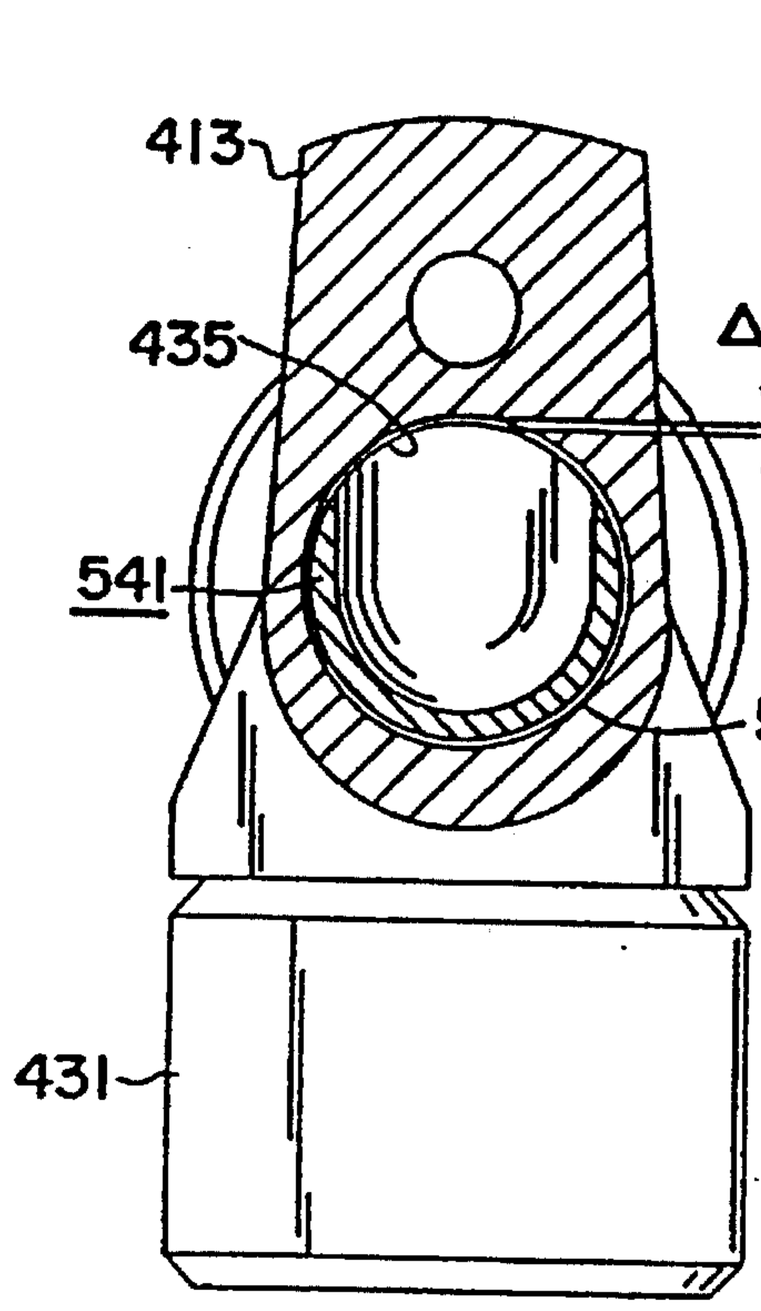


FIG.23

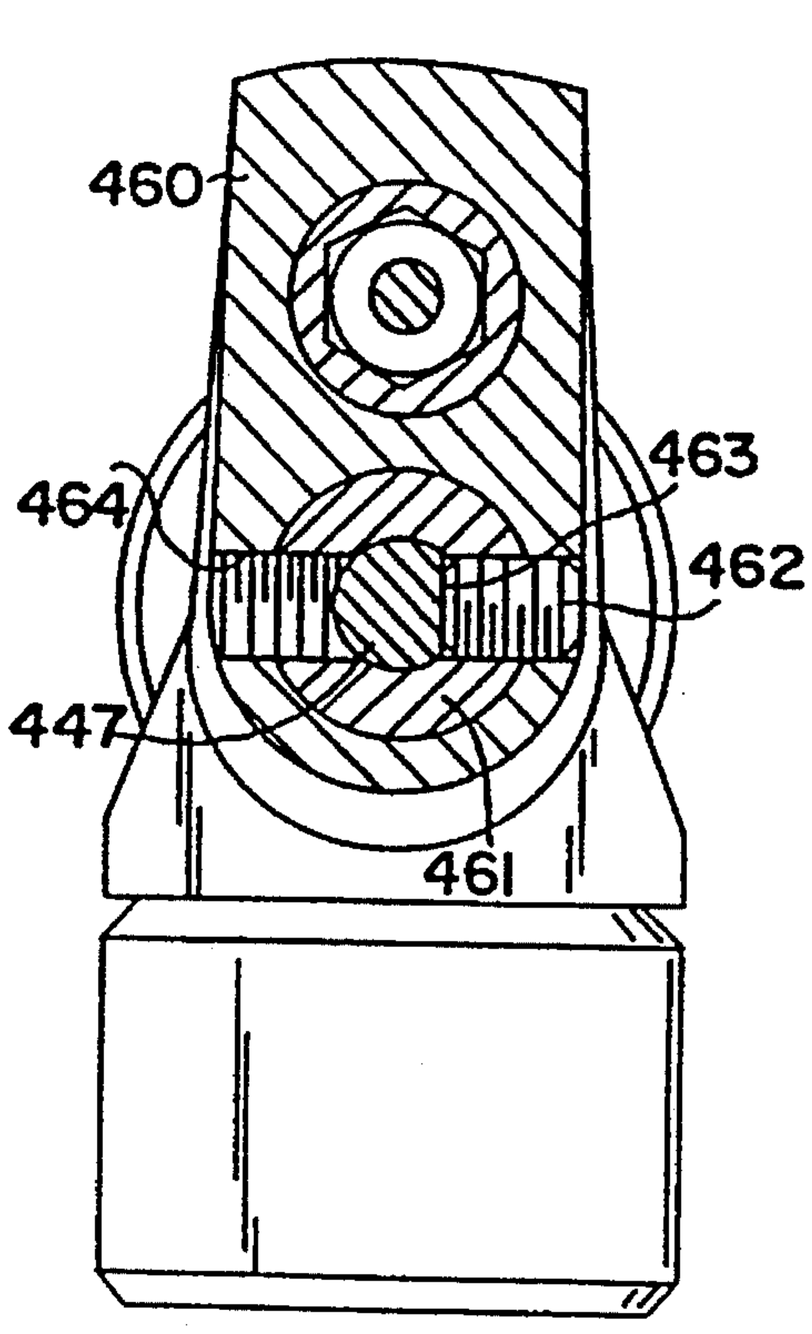


FIG.24

FIG. 25

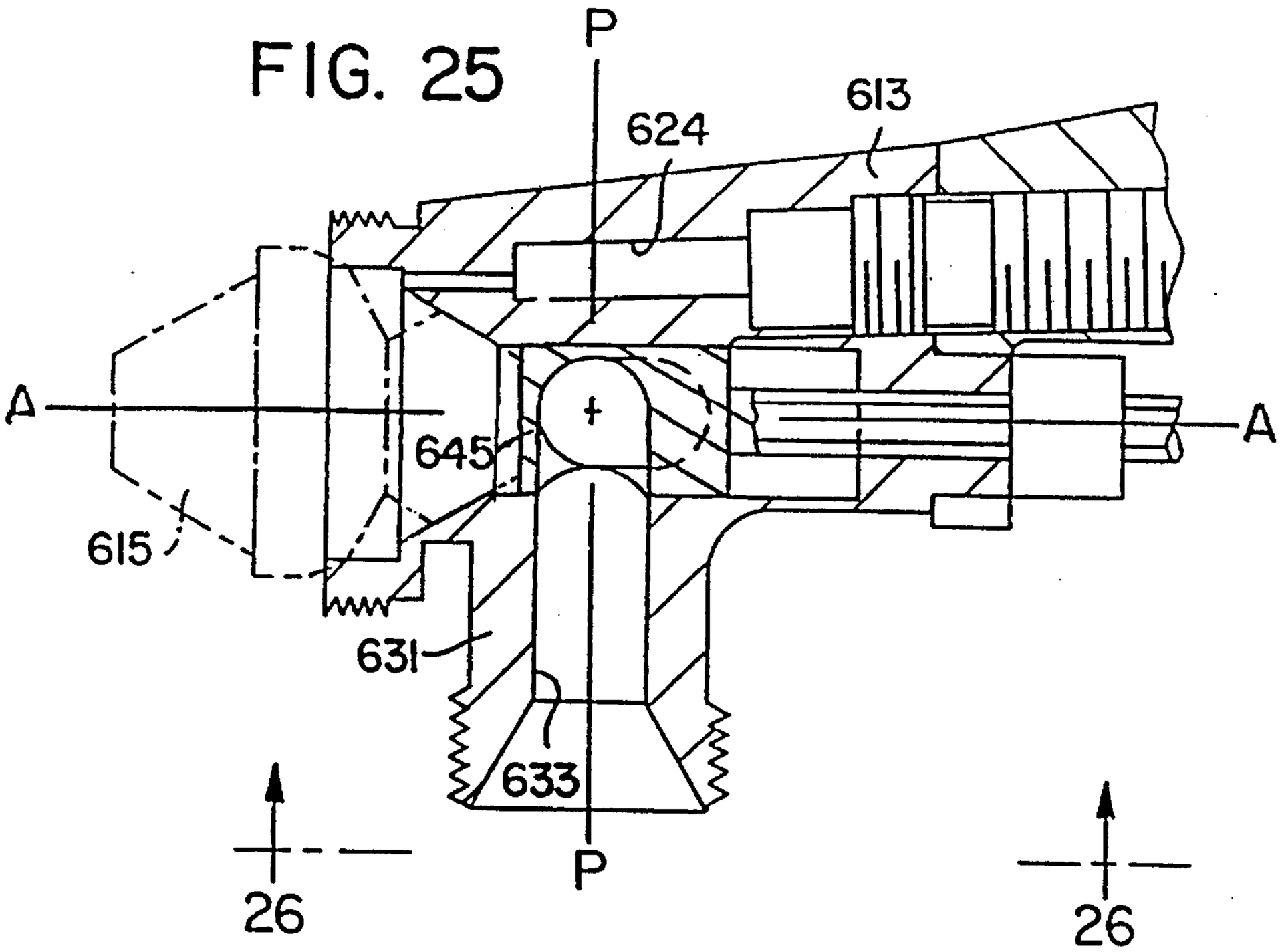
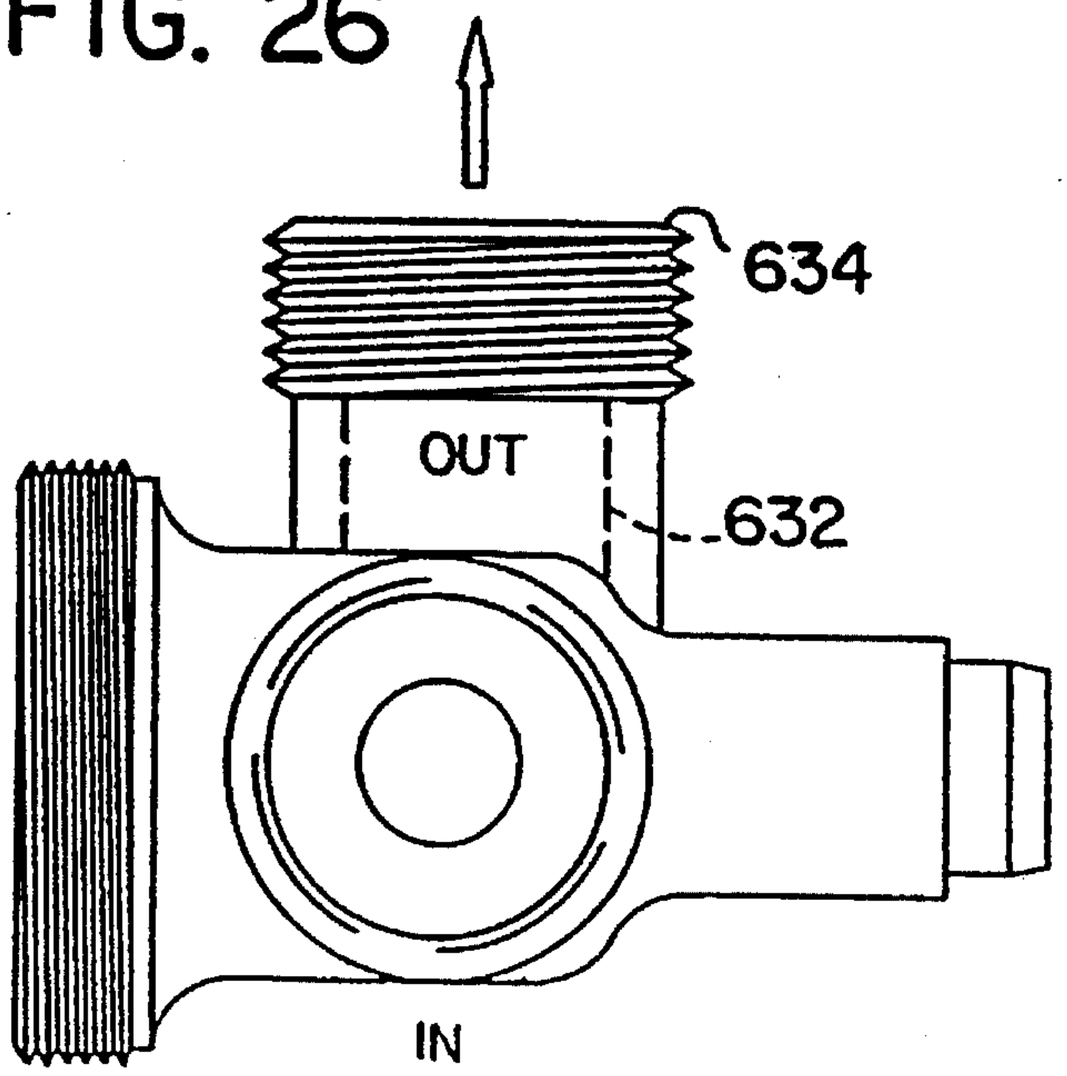


FIG. 26



SPRAY GUN ASSEMBLY AND SYSTEM FOR FLUENT MATERIALS

This is a continuation-in-part application of the application Ser. No. 08/138,473, filed Oct. 15, 1993, entitled SPRAY GUN FOR AGGREGATES, now U.S. Pat. No. 5,370,315.

FIELD OF THE INVENTION

The present invention relates to spray guns and particularly to spray guns adapted for spraying fluent materials which have a high viscosity and/or a concentration of particulates which may be fibrous and/or abrasive and/or aggregate materials; especially particulate-loaded cement or mortar, such as plaster or conventional stucco or synthetic stucco which is most commonly called exterior insulation finish systems (E.I.F.S.).

BACKGROUND OF THE INVENTION

It has been known that in order to provide an effective spray apparatus for materials with a high particulate content, it is necessary to provide means for maintaining a continuous circulation of the particulate-laden liquid both during the periods when the liquid is being sprayed and during intermediate periods when the spray is interrupted. A continuous circulation of liquid serves to maintain the particulate material in suspension within the carrier liquid.

Conventional valving arrangements have proven to be unsatisfactory for fluent materials in which the particulate material is highly abrasive.

Merely circulating particulate material in a suspension with a carrier liquid, is not, by itself, an answer to all of the problems encountered in spraying high particulate content fluent material. Large particulate material and solutions having particulate material with a wide range of particle size, such as fibers and other aggregate suspensions, not only plug orifices that are the same size or slightly larger than the large particulates, but these larger particulates also agglomerate in large openings impeding or actually blocking the opening, making it difficult, if not impossible, to use these fluent materials in a spray apparatus.

Another difficulty encountered with large particulate materials in suspension arises because the larger particulates tend to pack in, or agglomerate, in valve seats and other openings in a spray apparatus so that the opening or closing of apertures or valves becomes inefficient or even impossible after a short period of use.

In some instances, even where an effective spray apparatus has been provided which permits the continuous recirculation of fluent materials in order to maintain particulate material in suspension within the carrier liquid, that feature is not necessary for some solutions or suspensions, such as paint and the like which do not contain a significant quantity of particulate material. Continuous recirculation in these cases is inefficient, using substantially more energy and equipment, and subjects the spray apparatus to additional sources of leakage.

Accordingly, it would be of great advantage to the art if a spray apparatus could be convertible between a continuous recirculation device, which maintains particulate material in suspension within the carrier liquid and, in its alternative embodiment, a spray apparatus which provides for direct passage of the fluent material through the apparatus without recirculation.

The size of existing spray apparatus, and particularly existing spray guns, has been found to be a limitation as even larger particulate material is used in the particulate laden carrier liquid. The large sized particulate material has been found to require orifices or openings which are too large for conventional spray guns. It would be a great advance in the art if a valving arrangement could be provided which would permit the use of conventional sized spray guns while accommodating larger particulate material in suspension within the carrier liquid.

SUMMARY OF THE INVENTION

With the foregoing in mind, the present invention provides a novel spraying apparatus which has improved means affording recirculation of the spray liquid which avoids harmful effects from the presence of fibrous or abrasive particles in the spray liquid.

The apparatus of the present invention minimizes the opportunity for the particles of the liquid to lodge in the apparatus and interfere with the operation of the spray gun or cause deterioration of the same.

More specifically, the present invention provides a spraying apparatus having an improved valve construction which affords continuous circulation of spray liquid through the apparatus both when the apparatus is operating to spray the spray liquid and when the apparatus is operative to interrupt the spray of the spray liquid, and at all positions therebetween.

The valve of the present invention has a valve element which cooperates with the inlet for the spray material to provide a shearing action between the valve element and the valve chamber which is effective to disintegrate any particulate material which might lodge between the valve element and the chamber, thereby avoiding inadvertent interruption of the spaying operation.

The valve of the present invention provides facile incremental adjustment of the flow through the spray head for spray liquids having a wide variation in particle content, viscosity, and abrasiveness.

In its preferred embodiment, the present invention has been found to be highly effective in minimizing the effects of large particulate containing fluent materials. This is accomplished by providing an opening for the fluent material flow that is divided into partial flows for both spraying and for recirculation, wherein the size of each opening is at least about four times greater than the size of the largest particulate in the fluent material. In a most preferred embodiment, the inlet which is subjected to the valve element causing the partial flow in two directions, has an elliptical configuration or generally oval cross section with the longer portion aligned with the direction of displacement of the valve element. This elliptical configuration allows for larger openings without requiring the redesign of the rest of the spray gun.

It has also been found that substantially longer wear and less plugging of the spray gun is accomplished when the valve element is sized to fit in the chamber with a clearance less than the diameter of the smallest particulate in the fluent material. In order to deal with both extremely large and extremely small particulate matter, it is essential that the valve element be able to terminate the forward spray without difficulty. This is accomplished in the present invention by having the cooperative surfaces of the valve chamber and the valve element at the point where the valve element engages the chamber be sharp edges so that as the valve

element is displaced to the closed position, the sharp edges cut or scrape the particulates out of that intersection point to permit effective closure.

In yet another preferred embodiment of the present invention, it has been found that the device can be converted to a non-recirculating spray gun. This is accomplished by providing a valve element that is sized to be positioned in the chamber both as previously positioned and also in the chamber after 180° rotation of the element. The valve element, on its diametrically opposed side presents a surface blocking flow through the inlet and the outlet in the closed position of the valve and permits flow only through the inlet and through the spray nozzle in the open position of the valve.

The present invention also provides an improved nozzle with an effective seal that allows improved mixing of the fluent material with the air. In addition, the nozzle can be replaced or changed while the spray gun is in the recirculating mode.

Finally, an alternative embodiment has been discovered which permits the use of a shorter spray gun by placing the inlet and outlet in a side by side tandem position generally perpendicular to the major axis of the gun causing recirculation to exit to the side rather than to the rear of the gun. This permits a shorter, more compact design while retaining all of the features of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

All of the objectives of the present invention are more fully set forth hereinafter with reference to the accompanying drawings, wherein:

FIG. **1** is an elevational view of a spray gun embodying flow control apparatus for the spraying liquid in accordance with the present invention, the portions of the gun being broken away to illustrate the valve which is in its closed position;

FIG. **2** is a fragmentary view of the gun shown in FIG. **1** showing the valve in its fully opened position;

FIG. **3** is an enlarged view of the valve element with portions broken away to show its construction;

FIG. **4** is a view similar to FIG. **1** showing a modified spray gun having a second embodiment of a valve, the valve being shown in closed position;

FIG. **5** is a fragmentary view of the gun shown in FIG. **4** with the valve in open position;

FIG. **6** is an elevational view of the valve element in FIG. **5** with portions broken away and showing the stator component of the gun in broken lines;

FIG. **7** is a view similar to FIG. **4** of a further embodiment of a spray gun embodying the present invention with the valve in closed position;

FIG. **8** is a fragmentary view of the apparatus shown in FIG. **7** with the valve in open position; and

FIG. **9** is a view of the valve element with portions broken away and showing the movable return outlet in dot-and-dash lines.

FIG. **10** is a view similar to FIG. **1**, but showing the spray gun having modified inlet and outlet fluid ports of elliptical configuration.

FIG. **11** is an enlarged fragmentary, sectional, elevational view of the gun head shown in FIG. **10**, illustrating the elliptical fluid inlet and outlet ports in relation to the actuated position of the fluid return valve.

FIG. **12** is a sectional, bottom plan view taken along the stepped line **12**, **12** of FIG. **11**, showing the elliptically shaped inlet and outlet fluid ports with respect to the return valve in an actuated position.

FIG. **13** is an enlarged side elevational view of a modified spray gun with portions broken away and in section, illustrating details of the modified spray gun.

FIG. **14** is an enlarged, fragmentary elevational view of the details contained within the dot and dash box of FIG. **13** which is designated FIG. **14**.

FIG. **15** is a bottom sectional plan view taken along the stepped line **15**, **15** of FIG. **14**, showing the elliptical fluid inlet and outlet ports and the equal area relationship of the fluid inlet port to the actuated position of the valve.

FIG. **16** is an enlarged sectional elevational view taken along the line **16**, **16** of FIG. **14**, showing cross sectional details of the valve and its dimensional designed clearance in its housing to allow fluid only floating of the return valve body.

FIG. **17** is an enlarged sectional view taken along the line **17**, **17** of FIG. **14**, showing the means by which the return value body cavity is maintained in vertical alignment with the fluid inlet and outlet ports.

FIGS. **18**A–**18**D are enlarged front elevational views of four interchangeable nozzles that may be used with the spray gun shown in FIG. **13**.

FIGS. **19**A–**19**D are sectional, elevational views of each of the nozzles shown in FIGS. **18**A–**18**D, respectively, along the respective lines **19**A, **19**A through **19**D, **19**D.

FIG. **20** is a side elevational view of another modification, illustrating the spray gun of FIG. **13**, having been converted to a so-called "dead-end" spray gun utilizing only the fluid inlet port with no return port opening.

FIG. **21** is an enlarged fragmentary sectional elevational view of the detail contained within the dot and dash box of FIG. **20** and designated as FIG. **21**.

FIG. **22** is a bottom plan sectional view taken along the stepped line **22**, **22** of FIG. **21**.

FIG. **23** is an enlarged transverse sectional elevational view taken along the line **23**, **23** of FIG. **21** showing the return valve in an inverted position.

FIG. **24** is an enlarged transverse sectional elevational view taken along the line **24**, **24** of FIG. **21**, shown the means by which the return valve is maintained in an inverted position and vertically aligned with the fluid inlet and outlet parts.

FIG. **25** as seen from the line **26—26** but showing the spray gun being modified to place the outlet fluid port to the side rather than to the back of the spray gun, the nozzle being shown in broken lines.

FIG. **26** is a view of the inlet and outlet ports as seen from the line **26—26** in FIG. **25**, disassembled from the spray gun and shown rotated 90°.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** illustrates a spray gun embodying a flow control valve for the spray fluid made in accordance with the present invention. The gun is designed for dispensing a spray fluid in the form of a liquid aggregate. The spray gun **12** has a barrel **13** and a handle **14**. At the distal end of the barrel **13**, a spray nozzle **15** is mounted to discharge the spray fluid in a spray pattern of a selected design. In the present instance,

the gun nozzle **15** incorporates peripheral air outlets at **17** which are designed to envelop the spray pattern with a discharge of compressed air. Compressed air is introduced into the nozzle through an air passage **21** and is controlled by a valve **22** having an operator **23** which is selectively operable to introduce compressed air into an air passage **24** in the barrel leading to an air plenum **25** surrounding the nozzle. Actuation of the operator **23** is achieved by trigger **26** pivoted to the barrel at **27** and operable to be pressed toward the handle by either two or four fingers of the operator. The foregoing components are standard operating components of a spray gun, and further description thereof is not deemed necessary.

In accordance with the present invention, means is provided to effect a continuous circulation of spray fluid through the spray gun. In the present instance, the gun is designed to accommodate a spray liquid having carrying particulate material having fibrous and/or abrasive components. To this end, the barrel **13** has an interior axial wall defining an elongated tubular bore forming a valve chamber **35**. The barrel is provided with a first nipple **31** for the intake of the spray fluid and a second nipple **32** for the discharge of the spray fluid. In the present instance, the nipples **31** and **32** are positioned adjoining one another in close parallel relation, each nipple having an axial bore **33** or **34** opening into the axial wall of the valve chamber **35** which extends therebetween. The end of the valve chamber proximate the handle **14** is closed, for example by an end wall **36** and is vented as indicated at **37**. The distal end of the valve chamber is provided with internal threads **38** to receive the nozzle **15** which has a threaded portion passing through the plenum **25** into engagement with the internal threads **38** of the valve chamber. The hollow interior **54** of the spray nozzle **15** communicates with the valve chamber **35** at its distal end.

A shuttle valve element **41** is positioned for axial displacement in the chamber **35**. As shown in FIG. **3**, the valve element **41** has a hollow body shell **42**. The outside of the hollow shell **42** has a sliding fit with the interior wall of the chamber **35** and has an opening **43** extending along the length of the bottom of the body so as to allow the hollow interior **44** of the body to communicate with the inner ends of the bores **33** and **34**. At its forward end, the valve element **41** has a transverse forward partition **51** with a forwarding projecting nose portion **46** which extends into the interior **54** of the nozzle **15** as shown in FIG. **2**. At its rear end, the valve element **41** has a transverse rear partition **52** and a rearwardly projecting stem **47** which passes through the end wall **36** and terminates in an operator **48** which is threadedly engaged in the stein **47**. The operator is actuated by the trigger **26** by engaging in a slot within the trigger. Thus, as the trigger is operated to open the valve **22** through the operator **23**, it also displaces the valve element **41** to the right. When the trigger is actuated, the air line to the passage **24** is opened at the same time as the valve element is moved to the right which effects communication between the inlet bore **33** and the hollow interior of the nozzle **15**. When fully opened, as shown in FIG. **2**, the front partition **51** (FIG. **3**) is positioned across the middle of the bore **33** so as to divide the flow of the liquid aggregate approximately equally between the hollow interior **44** of the valve element and the hollow interior **54** of the nozzle. The projecting nose **46** of the valve element reduces the flow area through the hollow interior **54** of the nozzle **15**, so as to maintain the desired velocity in the liquid discharged into the interior of the nozzle, thereby avoiding a reduction in velocity which might otherwise cause the particulate material in the flow to settle out and accumulate in the hollow interior **54** of the nozzle **15**. It is noted that at the base of the nose portion **46**, the cross section of the nose portion **46** flares smoothly as indicated at **56** into the outer perimeter of the forward partition **51** of the valve element **41** to provide a smooth forward-flow passage. Likewise, the hollow interior **44** of the valve merges into the back of the forward partition **51** and the front of the rear partition **52** to provide a smooth flow passage for the rearward flow. The flow passages through the bore **33**, the interior of the shell and the bore **34** are all of approximately the same flow area and devoid of obstructions which could throttle or otherwise interfere with the recirculating flow therethrough.

The present design has been found to enable facile adjustment of the flow incrementally from and a pre-set minimum rearward flow at the fully open position one limit, and "zero" forward flow and maximum rearward flow at the closed position at the opposite limit. If it is desired to alter the proportion of flow at the fully opened position, the operator **48** may be adjusted relative to the stem **47**. In any event, care must be exercised to ensure a sufficient proportioning of the rearward flow through the valve element and into the outlet to maintain a minimum flow through the spray liquid lines to the inlet **31** and outlet **32** when the valve is fully opened. By maintaining a predetermined minimum flow through the lines, it is possible to use lines of smaller diameter with the result that the volume of spray liquid in the lines is similarly reduced so as to reduce the overall weight of the spray gun during its use. Maintaining the pre-set minimum flow avoids clogging of the line which would be a problem if flow through the line were arrested when the nozzle is open.

Displacement of the valve element causes the partition **51** to sweep across the mouth of the bore **33** in the axial wall of the chamber **35**. The outer perimeter of the partition provides sharp edges on opposite side which cooperate with the sharp outline of the mouth to provide a shearing action which severs or disintegrates any particulate matter which might tend to lodge between the valve element and the valve chamber wall across the mouth of the bore **33**. This shearing action is particularly effective when the spray liquid carries fibrous particles, as is the case when the spray liquid is fiber-loaded cement or mortar. To achieve this shearing action, the clearance between the sharp edge of the partition the sharp outline of the mouth should be less than the thickness of the particles in the particulate material carried in the spray liquid.

FIGS. **4**, **5** and **6** illustrate an alternative construction which may be desired for use with the liquids having a high tendency to effect precipitation of particular matter. FIG. **4** illustrates a modified construction of a gun housing **112** in which the valve chamber **35** of the embodiment of FIG. **1** is modified as shown at **135** to accommodate a longer valve element **141**. The hollow interior **144** of the valve element **141** is extended axially to the rear towards the handle to accommodate a stator plug **161** slidable within the hollow **144** of the valve element and which is fixed in position within the chamber **135** by a anchoring element **162**. The stator plug **161** provides a transverse stator surface which is fixedly mounted in registry with the far side of the outlet bore **134**, and allows the valve element **141** to be displaced towards the handle without leaving a pocket between the rear partition **152** of the valve element **141** and the rear edge of the port connecting the bore **134** of the outlet nipple with the chamber **135**. It should be noted that in FIG. **2** there is a pocket formed when a rear wall **52** of the valve element is displaced to the open position. The stator surface is flared to

merge into the interior surface of the shell forming the hollow interior **144**.

In other respects, the valve element **141** is similar in function and construction to the valve element **41** of the embodiment in FIGS. **1–3**.

FIGS. **7–9** illustrate another embodiment of the invention which avoids the formation of a pocket in the flow path for the recirculating material. To this end, FIG. **7** illustrates a modified construction embodying a valve element **241** similar in configuration and function to the elements **41** and **141**. In this embodiment of the invention, a spray gun housing **212** is provided with a fixed inlet nipple **231** having an inlet bore **233** and a movable outlet nipple **232** having an outlet bore **234**. The movable outlet nipple **232** is mounted on the modified valve element **241** to register with the interior surface of the rear partition **252** of the hollow **244** of the valve element. In the present instance, the nipple **232** is removably mounted on the valve element with seals **262** and a set screw (not shown). Thus, as the valve is displaced between its closed and open positions, the nipple **232** moves with the valve element **241** as shown in FIGS. **7** and **8**. The contoured surface rear partition **252** is fixed in alignment with the bore **234** to provide a smooth flow passage for the recirculating liquid aggregate. To provide a sliding support for the proximate handle end of the valve element, the end wall **236** of the valve chamber **235** is provided with a bottom support **263** having an upstanding guide element **264** adapted to engage in a guideway **265** in the handle end of the valve element. The guide **264** and guideway **265** restrict rotation of the valve element **241** as it is actuated between its open and closed positions. As with the valve element **141**, the element **241** is similar in configuration and function to the valve element **41**.

It is noted that the hollow interior of the valve element in all three embodiments of the present invention provides a smooth flow passage which is approximately equal in flow area to the flow passages provided through the bores of the inlet and outlet nipples. The transverse inner walls of the partitions at the opposite ends of the valve element merge into the interior axial wall of the hollow with a gradual flare as shown. In this way, the valve element avoids any substantial throttling or disruption of the flow of the spray liquid introduced through the inlet nipple, enabling the spray liquid to be pumped to and through the spray gun at the desired flow rate without being substantially affected by opening and closing the valve.

The guns illustrated in the drawings are suitable for spraying liquid aggregates which have a relatively high viscosity and/or a high particle content. The spray liquid flows through the valve chamber and the nozzle without excessive leakage or infiltration of the spray liquid into the operating parts of the gun. For aggregates with discrete particles, it has been found that the clearance between the valve element and the valve chamber wall should be less than the size of the particles, so that when the valve element is at rest, the particles serve to block the flow of the spray aggregate through the clearance spaces in the assembly. As the valve element moves, the confronting edges disintegrate the particles by a shearing action. The enlarged clearances facilitate the cleansing of the spray apparatus at the end of the day, when the apparatus is flushed with water or another cleaning liquid. For lighter liquids having a greater ability to penetrate clearance spaces, it may be desirable to provide additional sealing components in the form of auxiliary seals or in the form of leak-resisting coatings or materials for the movable components.

FIGS. **10–12**, inclusive illustrate another embodiment of the present invention generally similar to that shown at FIGS. **1–9** described above. The elements of this embodiment which are the same as the previously described embodiment bear the same reference numerals. New or modified parts are given new reference numbers in the 300 series.

The spray gun generally designated by the numeral **312** includes a barrel or body portion **13** formed from an aluminum alloy having a handle **14** depending from one end thereof, a valve chamber **35**, and a valve element **41** slideably mounted in the valve chamber between open and closed positions. The spray gun **312** also includes inlet and outlet fittings communicating with the valve chamber **35** which are externally threaded to attach flexible lines for connection to a fluent material supply source. The valve element **41** is generally biased to a closed position by a spring biased trigger **26** whereby fluent material is recirculated in a closed loop including the hollow interior **44** in the valve element **41** which defines a recirculation passageway or chamber. When the trigger **26** is retracted to displace the valve element **41** rearwardly to the open position (FIG. **11**), a portion of the fluent material is directed to the discharge nozzle **15** and a portion is recirculated. Note that in this position the front wall of the valve element is located approximately at the midpoint of the inlet opening **333**.

The fluent materials including particulates or aggregates of various sizes or fibers require a flow area of a predetermined minimum size in order to prevent so-called plugging in the spray gun and recirculating system by obstructing or closing the flow areas. In the present instance, a critical flow area is in the region where the flow of the fluent material at the inlet **333** is split when the valve element **41** is in the open position. Accordingly, in order to minimize the possibility of plugging in this split flow area, the inlet and outlet openings **333** and **334** are of non-circular cross section adjacent the valve chamber **35**. Preferably, the openings are oval shaped with the major axis A_m aligned with the axis A—A of the valve chamber **35**. Further, the distance D between a transverse plane P—P through the sharp edge **329** on the front face of the valve element divider **341** is spaced at least about four times the diameter of the largest particulate in the fluent material. Note also in FIG. **11** that the back edge of the partition **341** is likewise spaced a predetermined distance D_1 at least about four times the size of the largest particulate.

It is noted that the interaction of the sharp edge **329** of partition or divider **341** and sharp edge **328** of valve chamber **35** operate to scrape or dislodge any particulate material and shear any fiber, during actuation of the valve element **41** to a closed position to permit full closing of the valve element **41**. It is also noted that the non-circular or oval shaped configuration of the inlet and outlet port provides the desired increased flow area in critical flow areas to eliminate the possibility of plugging without requiring an increase in the size of the gun in a width-wise direction. Circular openings of a comparable size increase the dimensions and size of other components of the gun thereby adding weight, decreasing maneuverability and increasing cost of manufacture.

There is illustrated in FIGS. **13–17** inclusive, another embodiment of spray gun in accordance with the present invention. The major elements of the gun are generally similar to the previously described embodiments. The elements of this embodiment which are the same as the previously described embodiment bear the same reference numerals. New or modified parts are given new reference numbers in the 400 series.

Thus the spray gun generally designated by the numeral **412** includes a gun head or body **413** and a handle **414**

depending from one end of the gun head **413**. Fluent materials from a fluid supply source **430** are delivered under pressure through line **439** to inlet fitting **431** and inlet port **433** through recirculation chamber **444** in valve element **441** through outlet opening **434**. When valve element **441** is retracted to an open position to discharge fluent materials by actuating trigger **26** rearwardly toward the handle **414** to position the valve element **441** and parts as shown in FIG. **14**, pressurized air is delivered to the nozzle **415** through passageways in the spray gun to discharge fluent material in a pattern of desired texture. More specifically, the valve element **441** has a valve stem **447**^{a} projecting from its rear face which mounts a pair of adjustable collars **449** and **453** which straddle the trigger **26** in the manner shown in FIG. **13**. A spacer pin **447** (FIG. **13**) abuts valve stem **447**^{a} and is disposed between the valve stem **447**^{a} and fluid control assembly **448** which has an internal adjustable stop for selectively determining the open position of the valve element **441**. The collars **453** and **449** are adjustable axially relative to valve stem **447**^{a} and held in a desired orientation by set screws **455** and **449**^{a}. The collar **453** is positioned on valve stem **447**^{a} to abut shoulder **460** when the valve element **441** is in the closed position as shown in FIG. **13**. Accordingly, even when the fluent supply system recirculates fluent material, the nozzle **415** can be removed if desired and replaced, for example, with a different nozzle to change spray pattern. As noted the fluent control assembly **448** determines the open limit position for the valve element **441**.

In accordance with this embodiment of the invention, the inlet and outlet openings **433** and **434** are also of non-circular cross section, preferably oval shaped having a major axis aligned with the axis A—A of the valve chamber **435** to provide the desired flow area in the open position of the valve, that is at least about a 4 to 1 ratio to the largest particulate in the fluent material being processed. Further, in the present instance, the valve element **441** has a planar front axial end face **445** defining a sharp circumferentially extending edge **429** which cooperates with the sharp edge **428** of the valve chamber **435** to provide the shearing and dislodging action of fiber and particulate in the fluent material and prevent plugging when the valve is actuated from open to closed positions.

The radial clearance Δx (FIG. **16**) between the valve element **441** and the valve chamber **435** is preferably smaller than the smallest particulate in the fluent material, preferably not greater than 0.001 inches. In other words, the diameter of the valve element **441** is about 0.002 inches smaller than the diameter of the valve chamber **435**. By this relationship, the carrier liquid in the fluent material will function as a lubricant in the interface between the valve element **441** and valve chamber **435** while preventing ingress of the smallest particulate matter in the fluent material. In accordance with this embodiment of the invention, the nozzle **415** is characterized by novel features of constructions and arrangement facilitating easy and quick change over when it is desired to vary the spray pattern of the fluent material. The nozzle **415** also has a configuration which cooperates with the valve element **441** to ensure a relatively tight sealed relationship between the parts when the valve element **441** is in a closed position. Thus, the nozzle comprises a body portion having a stepped axial bore **470** extending therethrough having an outer discharge end **421**^{a} and having an inner end **421**^{b} confronting a chamber **471** (FIG. **14**) in front of the axial end face of the valve element **441**. The outer peripheral surface of the front end of the nozzle **415** is tapered or of frustro conical shape. The rear portion likewise has a tapered outer peripheral surface **472** which complements the shape of the tapered valve seat **420** which it engages in the assembled relation. The juncture of the front and back of the nozzle is defined by a radially outwardly directed, circumferentially extending shoulder **422** engagable by a cap **416** which threadedly engages complementary threads on the front end of the gun to seat the nozzle **415**. The nozzle **415** may be removed and replaced by removing the cap **416** as indicated in broken lines at **415'** and **416'** in FIG. **13**.

The inner end of the bore which extends inwardly from its discharge end **421**^{a} is beveled to define a sharp circumferentially extending edge **476** which abuts the planar end face **445** of the valve element **441** in the closed position as illustrated in FIG. **13**. An O-ring **473** engaging in a groove in the tapered rear face **472** of the nozzle provides a seal at the interface with the tapered valve seat **420**. The tapered rear face **472** has a peripheral circumferentially extending cut out defining a circumferential manifold **474** in fluid communication with pressurized air supply port **474***a* to deliver pressurized air to the axial bore **421** in the nozzle through angled circumferentially extending connecting ports **415***a*. As in the previous embodiment, the interaction of sharp edge **476** and planar end face **445** operate to shear or dislodge any fiber or particulate material during activation of the valve dement **441** to a closed position to permit full closing of the valve element **441**.

FIGS. **18**Aa–**19**D inclusive, show various nozzle embodiments in accordance with the present invention facilitating different spray patterns and use with different fluent materials. Accordingly, in the embodiment illustrated in FIGS. **18**A and **19**A, the discharge end **484** nozzle **480** has an axial bore **421** whose is outwardly flared at an included angle of about 45° and is oval shaped in cross section. In the embodiment shown in FIGS. **18**B and **19**B, a nozzle **481** has a bore whose discharge end **485** is likewise outwardly flared at an included angle of about 30° and is oval shaped in cross sections similar to the previously described embodiment. The nozzle **482** shown in FIGS. **18**C and **19**C is the same general configuration as the nozzle **415** described in connection with FIG. **13** spray gun embodiment of the invention, having a stepped bore **486**. The nozzle **483** shown in FIGS. **18**D and **19**D does not have the angularly disposed air distribution ports or holes and is adapted for use with cementitious material which are poured rather than sprayed.

FIGS. **20**–**24**, inclusive show another embodiment of the spray gun in accordance with the present invention. The elements of this embodiment which are the same as the previously described embodiment bear the same reference numerals. New or modified parts are given new reference numbers in the 500 series.

This embodiment of spray gun is useful for spraying highly aggregated fiber filled paints and other fluent materials which have a long pot life. In other words these fluent materials do not set or settle out if properly maintained. With these materials there is no need for a continuous recirculating system.

In this embodiment, the valve element **541** is simply rotated 180° to present the closed wall **544** of the valve element to the inlet and outlet openings **433** and **434** in the nipples **431** and **432**. (See FIGS. **20** and **23**). The valve stem **447** has a flat **463** on one face thereof and the shoulder **460** has threaded bores **464** on either side of the opening through which the valve stem **447** passes so that the set screw **462** can position the valve element **541** in two positions rather easily. Accordingly, as illustrated in FIG. **21**, when the valve is actuated to an open position, all of the fluent material is

directed past the leading edge **529** to the axial bore **470** of the nozzle **415** and is discharged in a spray pattern in the manner described previously.

FIGS. **25** and **26** show still another modified embodiment of the spray gun in accordance with the present invention. The elements of this embodiment which are the same as the previously described embodiment bear the same reference numerals. New or modified parts are given new reference numbers in the 600 series.

The basic elements of the gun including the nozzle **615** are generally similar to that described previously. However in the present instance, there is a novel arrangement of the inlet and outlet ports **633**, **634**, respectively, to provide a more compact overall design. More specifically, in the present instance, the inlet port **633** and the outlet port **634** are in angularly disposed nipples **631** and **632** projecting from a barrel **613**, and are generally aligned in a common plane P—P extending transversely to the axis A—A of the valve chamber **635**. The inlet and outlet ports **633**, **634**, respectively are circumferentially spaced apart, in the present instance 90°. In the illustrated embodiment, the axes of the parts intersect. There is a valve element **645** having a valve stem **647**^{a} slidable in the barrel **613**, and an air passage **624** leads to the nozzle **615**. The cut-out or chamber in the valve element **645** is significantly smaller in the axial direction. Accordingly, when the valve element **641** is in a closed position (FIG. **25**), fluent material entering the inlet **633** passes directly and freely to the outlet port **634** and the gun is in a recirculating mode. When the valve element **645** is displaced rearwardly to an open position positioning front partition of valve element **645** midway of the inlet port **633**, a portion of the fluent material is directed to the nozzle **615** and the remaining portion is directed to the outlet port **634** as in the previously described embodiments.

Even though the inlet and outlet ports **633**, **634**, respectively may be of various cross sectional configurations, a preferred arrangement is an inlet port **633** of circular cross section and outlet port **634** of oval shaped cross section.

Further, in the open position, outlet port **634** is flush with the rearward wall of the valve chamber and thus presents no pocket, or eddy allowing accumulation of aggregate in the chamber behind outlet port **634** which would inhibit closing valve element **641**.

Even though particular embodiments of the present invention have been illustrated and described herein, it is not intended to limit the invention and changes and modifications may be made therein within the scope of the following claims.

What is claimed is:

1. A spray gun for spraying fluent materials comprising:

a valve chamber;

a nozzle connected to said chamber at one end thereof;

inlet and outlet ports communicating with said valve chamber;

a valve element having a hollow interior displaceable in said chamber between closed and open positions;

said valve element operable in the closed position to extend between said inlet and said outlet ports; said inlet and said outlet ports affording flow of material through said inlet port into said hollow interior of the valve element and out through said outlet port; and

said valve element in the open position operable to split the flow through said inlet port into a first partial flow through said hollow interior of said valve element and out through said outlet port, and a second partial flow through said nozzle, whereby the flow through said outlet port is uninterrupted when said inlet port is receiving the materials under pressure.

2. A spray gun as claimed in claim **1**, wherein the inlet and outlet ports adjacent said chamber are of non-circular cross section having a greater dimension in an axial direction of said chamber than in a direction transverse to said axial direction.

3. A spray gun as claimed in claim **2**, wherein said inlet and outlet ports are oval shaped.

4. A spray gun as claimed in claim **1**, wherein clearance between the valve element and chambers is in a range of about 0.002 inches.

5. A spray gun as claimed in claim **1**, wherein said valve element has an axial end face confronting the nozzle, at least a portion of said axial end face being planar, and wherein the nozzle has a sharp peripheral edge adapted to abut the planar portion of the axial end face of said valve element when said valve element is in the closed position.

6. A spray gun as claimed in claim **1**, wherein one axial end of said chamber has a conical outwardly tapered seat portion and said nozzle has a complementary frustoconical portion for engaging said seat.

7. A spray gun as in claim **6** further comprising a resilient sealing means in between said frustoconical portion of said nozzle and said tapered seat portion of said chamber.

8. A spray gun as claimed in claim **1**, wherein the inlet and outlet ports are axially spaced apart.

9. A spray gun as claimed in claim **1**, wherein said inlet and outlet ports are generally aligned in a common plane extending transversely to said chamber and the axis of said inlet port intersects the axis of said outlet port.

10. A spray gun as claimed in claim **1** wherein the nozzle includes an axial bore, a circumferentially extending manifold generally concentric to said axial bore, and a plurality of circumferentially spaced angularly directed radial ports extending from said bore to said manifold, and means to cause air to flow through said manifold and said radial ports into said bore.

11. A spray gun as claimed in claim **10** wherein an axial bore in said nozzle adjacent an outer tip thereof is flared outwardly and is of oval shaped cross section.

12. A spray gun as claimed in claim **10**, wherein an axial bore in said nozzle is flared outwardly adjacent a discharge end and is of circular cross section.

13. A spray gun as claimed in claim **1**, wherein said nozzle is a unitary, one piece construction including an axial bore formed therein for passing fluent materials.

14. A spray gun as claimed in claim **1**, wherein clearance between a front axial end face of said valve element and said inner peripheral edge of said nozzle when in said open position is at least about four times the size of the largest particulate in the fluent materials.

15. A spray gun as claimed in claim **1**, wherein clearance between said valve element and said chamber is less than the size of a smallest particulate in the fluent materials.

16. A spray gun as claimed in claim **1**, wherein means is provided for mounting the valve element in the chamber so that it may be selectively positioned with the hollow interior formed in the valve element defining a recirculating chamber facing downwardly in communication with said inlet and outlet ports and rotated to a position wherein the valve element blocks the inlet and outlet ports in the closed position of the valve element.

17. A spray gun as claimed in claim **1**, wherein said valve element is adjustable incrementally from said closed position to a fully open position, in said fully open position said

flow being apportioned approximately equally between the hollow interior of the valve element and the nozzle.

18. A spray gun as claimed in claim **1**, wherein said valve chamber has an interior axial wall defining an elongated tubular bore within the body of said gun, said inlet port into said interior wall, said valve element having a front transverse partition at one axial end of said hollow interior with an outline conforming to and slidable within said tubular bore between a closed position at the nozzle side of said inlet port and an open position intersecting said inlet port, whereby in said open position said front partition apportions the flow through said inlet port between the hollow interior of the valve element and said nozzle.

19. A spray gun as claimed in claim **18**, wherein the spray inlet port is defined by a mouth having a sharp outline, and a perimeter of said front partition has sharp edges on its opposite sides which cooperate with the sharp outline of the mouth to provide a shearing action upon displacement of said valve element from the open position toward the closed position.

20. A spray gun as claimed in claim **19**, for spraying fluent materials with a particulate content comprising particles having a thickness greater than a given dimension, the valve element providing a clearance space between said sharp edges and sharp outline which is no greater than said given dimension, whereby displacement of said valve element produces a shearing action disintegrating particles which may be positioned between either of said sharp edges and said sharp outline.

21. A spray gun as claimed in claim **20**, wherein said clearance space is sufficiently large to allow a cleansing liquid to flow therethrough when the gun is flushed.

22. A spray gun as claimed in claim **18**, wherein said front partition of said valve element has a nose projecting away from the hollow interior of the valve element, in the closed position, said nose being positioned within the interior of said spray nozzle and operable to be retracted upon displacement of said valve element toward said open position.

23. A spray gun as claimed in claim **18**, wherein said outlet port is in said interior axial wall and is in communication with the hollow interior of said valve element continually as said valve element is displaced axially of said tubular bore between the closed position and the open position.

24. A spray gun as claimed in claim **23**, wherein the valve element has an axial peripheral shell, said gun including a transverse stator surface fixedly mounted relative to said outlet port within said hollow interior, said transverse fixed surface having a flare merging into an axial interior surface of the shell of said valve element.

25. A spray gun as claimed in claim **18**, wherein the valve element has a peripheral shell and a rear transverse partition at an opposite axial end of said hollow interior of the valve element, inwardly-facing surfaces of said front and rear transverse partitions being flared into the peripheral shell of said hollow interior so as to provide a streamlined flow path for fluent materials flowing through said hollow interior.

26. A spray gun as claimed in claim **1**, wherein said valve element has a valve stem extending rearwardly out of said valve chamber, said stem having an operator for displacing the valve element, said spray gun including a trigger cooperable with said operator to displace said valve element incrementally between said closed and open positions.

27. A spray gun as claimed in claim **26**, including means to adjust said operator relative to said stem, whereby the fully open position of said valve element is adjustable.

28. A spray gun as claimed in claim **26**, wherein said spray gun includes means to supply compressed air to said nozzle and an air valve controlling the flow of the compressed air, said air valve having an operator coupled to said trigger whereby said compressed air is supplied to said nozzle concurrently with the displacement of said valve element to the open position.

29. A spray gun as claimed in claim **1**, wherein said valve element includes a nose projecting toward said nozzle effective to reduce flow area through said valve chamber to said nozzle for maintaining the velocity of the fluent materials during passage from said inlet port to said nozzle.

30. A spray gun as claimed in claim **1**, wherein flow passages of said valve inlet port, of said hollow interior of the valve element, and of said outlet port all provide a substantially equal flow area.

31. A spray gun as claimed in claim **1**, for spraying fluent materials with a particulate content comprising particles having a thickness greater than a given dimension, said valve element having a clearance space within said valve chamber which is no greater than said given dimension and being displaceably mounted in said chamber without seals or packings.

32. A spray gun as in claim **1**, wherein said valve element may be rotated to a position where said hollow interior of said valve element is not in fluid communication with said inlet port.

33. A nozzle for a spray gun having a tapered seat, a circumferentially extending manifold for delivering air under pressure to said nozzle, a valve chamber adjacent the seat, and a valve element in the chamber and actuatable between open and closed positions, the valve element having a flat planar surface on at least a portion of an axial end face confronting the seat, comprising:

a body portion having an axial bore for communicating at one end with the chamber and forming a discharge end at its opposite end;

a tapered inner portion engagable with the tapered seat and terminating in a sharp circumferentially extending edge for engaging the planar face of the valve element in the closed position; and

a plurality of circumferentially spaced ports communicating at inner ends with the axial bore and for communicating at outer ends with the manifold.

34. A valve element for a spray gun having an elongated valve chamber formed therein, a nozzle at one end of the chamber, and inlets and outlets communicating with the chamber forming part of a pathway for delivering fluent materials to the spray gun;

said valve element slidable in said chamber between a closed position and at least one open position, having an end wall forming a flat planar surface on at least a portion of the axial end face for confronting the nozzle, and side walls forming an arcuate cut-out defining a recirculating passageway when the valve element is in said closed position, when in said open position, said side walls and said planar surface of said end wall splitting flow through the inlet between flow through said passageway and flow through the chamber to the nozzle.

35. In a system for spraying fluent materials;

a fluid supply system for delivering fluent materials to a spray gun under pressure;

a spray gun having inlet and outlet ports forming a closed circuit with said fluid supply system and opening into a valve element chamber in said spray gun;

a valve element mounted in said chamber operable between open and closed positions and having formed

therein a cut-out defining a recirculating passageway to direct fluent materials in a closed loop when the valve element is in a closed position and permit discharge of a portion of the materials through a nozzle mounted at one end of the valve element chamber.

36. In a system for spraying fluent materials;

a fluid supply system for circulating fluent materials to and from a spray gun,

a spray gun having a nozzle, inlet and outlet ports, and a valve chamber between said ports;

a valve element mounted in said valve chamber operable between opened and closed positions, said valve element having a recirculating passageway for uninterrupted flow of fluent materials from said inlet to said outlet, and when in said open position, splitting flow between said recirculating passageway and said nozzle.

37. A spray gun for spraying fluent materials which have a high concentration of abrasive component and/or embodying a high particulate content, said gun comprising:

a valve chamber, a spray nozzle connected to said chamber at one end thereof, a fluent material outlet at the other end of said chamber, and an inlet intermediate said nozzle and said outlet for receiving said fluent material under pressure;

a valve element displaceable in said chamber between a closed and an open position, said valve element having a hollow interior operable in the closed position to extend between said inlet and said outlet, said hollow interior being in fluid communication with both said inlet and said outlet, said inlet and said outlet and said hollow interior of the valve element each having a flow passage affording flow of said fluent material through said inlet into said hollow interior of the valve element and out through said outlet;

said valve element in the open position operable to split the flow through said inlet into a first partial flow through the hollow interior of the valve element and out through said outlet, and a second partial flow through the spray nozzle, whereby the flow through said outlet is uninterrupted when said inlet is receiving said fluent material under pressure.

38. A spray gun according to claim **37** wherein said valve element is adjustable incrementally from said closed position to a fully open position, said valve element in said fully open position apportioning said flow approximately equally between the hollow interior of the valve element and the spray nozzle.

39. A spray gun according to claim **37** wherein said valve element has a valve stem extending rearwaraly out of said valve chamber, said stem having an operator for displacing the valve element, said spray gun including a trigger cooperable with said operator to displace said valve incrementally between said closed and open positions.

40. A spray gun according to claim **39** including means to adjust said operator relative to said stem, whereby the open position of said valve element is adjustable.

41. A spray gun according to claim **39** wherein the spray gun includes means to supply compressed air to said spray nozzle and an air valve for controlling flow of the compressed air, said air valve having an operator coupled to said trigger whereby said compressed air is supplied to said nozzle concurrently with the displacement of said valve element to the open position.

42. A spray gun according to claim **37** wherein said valve element includes a nose extending along the length of said chamber operable to project into said spray nozzle and effective to reduce the flow area through said valve chamber between said valve element and said nozzle for maintaining the velocity of fluent material during its passage from said inlet to said nozzle.

43. A spray gun for spraying fluent materials which have a high concentration of abrasive components and/or embodying a high particulate content, said gun comprising:

a valve chamber, a spray nozzle connected to said chamber at one end thereof, a fluent material outlet at the other end of said chamber, and an inlet intermediate said nozzle and said outlet for receiving said fluent material under pressure;

a valve element displaceable in said chamber between a closed and an open position, said valve element having a hollow interior operable in the closed position to extend between said inlet and said outlet and being in fluid communication with both said inlet and said outlet, said inlet and said outlet and said hollow interior of the valve element each having a flow passage affording flow of said fluent material through said inlet into said hollow interior of the valve element and out through said outlet;

said valve chamber having an interior axial wall defining an elongated tubular bore within the body of the gun, said inlet providing a fluent material inlet opening into said interior wall,

said valve element having a front transverse partition at one axial end of said hollow interior with an outline conforming to and slidable within said tubular bore between a closed position at the nozzle side of said fluent material inlet opening and an open position intersecting said fluent material inlet opening, whereby in said open position said front partition apportions of the flow of said fluent material through said fluent material inlet opening between a first partial flow through said hollow interior of the valve element and through said outlet of the chamber, and a second partial flow through said spray nozzle, whereby the flow through said outlet is uninterrupted when said inlet is receiving the spray material under pressure.

44. A spray gun according to claim **43** wherein said fluent material inlet opening is defined by a mouth having a sharp outline, and the perimeter of said front partition has sharp edges on its opposite sides which cooperate with the sharp outline of the mouth to provide a shearing action upon displacement of said valve element from the open position towards the closed position.

45. A spray gun according to claim **44**, wherein said particulate content comprises particles having a thickness greater than a given dimension, and the valve element provides a clearance space between said sharp edges and said sharp outline which is no greater than said given dimension, whereby displacement of said valve element produces a shearing action disintegrating the particles which may be positioned between either of said sharp edges and said sharp outline.

46. A spray gun according to claim **45** wherein said clearance space is sufficiently large to allow a cleaning liquid to flow therethrough when the gun is flushed.

47. A spray gun according to claim **43** wherein said front partition of said valve element has a nose projecting away from the hollow interior of the valve element, said nose in the closed position being positioned within the interior of said spray nozzle and operable to be retracted with movement of said valve element towards said open position.

48. A spray gun according to claim **43** wherein said outlet is in said interior axial wall and is in communication with the

hollow interior of said valve element continually as said valve element is displaced axially of said tubular bore between the closed position and the open position.

49. A spray gun according to claim **48** wherein the valve element has an axial peripheral shell, said gun including a transverse stator surface fixedly mounted relative to said outlet within said hollow interior, said transverse stator surface having a flare merging into the axial interior surface of the shell of said valve element.

50. spray gun according to claim **43** wherein the valve element has a peripheral shell and a rear transverse partition at the opposite axial end of said hollow interior of the valve element, the inwardly-facing surfaces of said forward and rear transverse partitions being flared into the hollow interior of said peripheral shell so as to provide a streamlined flow path for fluent material flowing through said hollow interior.

51. A spray gun for spraying fluent materials which have a high concentration of abrasive components and/or embodying a high particulate content, said gun comprising:

a valve chamber, a spray nozzle connected to said chamber at one end thereof, a fluent material outlet at the other end of said chamber, and an inlet intermediate said nozzle and said outlet for receiving said fluent material under pressure;

a valve element displaceable in said chamber between a closed and an open position, said valve element having a hollow interior operable in the closed position to extend between said inlet and said outlet and being in fluid communication with both said inlet and said outlet, said inlet and said outlet and said hollow interior of the valve element each having a flow passage affording flow of said fluent material through said inlet into said hollow interior of the valve element and out through said outlet;

said valve element in the open position operable to split the flow through the inlet into a first partial flow through the hollow interior of the valve element and through said outlet, and a second partial flow through the spray nozzle, whereby the flow through said outlet is uninterrupted when said inlet is receiving said fluent material under pressure;

the flow passages of said inlet, said hollow interior of the valve element, and said outlet all providing substantially the same flow area.

52. A spray gun for spraying materials with a particulate content comprising particles having a thickness greater than a given dimension, said gun comprising:

a valve chamber, a spray nozzle connected to said chamber at one end thereof, a material outlet at the other end of said chamber, and an inlet intermediate said nozzle and said outlet for receiving the material under pressure;

a valve element displaceable in said chamber between a closed and an open position, said valve element having a hollow interior operable in the closed position to extend between said inlet and said outlet and being in fluid communication with both said inlet and said outlet, said inlet and said outlet and said hollow interior of the valve element each having a flow passage affording flow of said spraying materials through said inlet, said hollow interior of the valve element and out through said outlet;

said valve element in the open position operable to split the flow through the inlet into a first partial flow through the hollow interior of the valve element and through said outlet, and a second partial flow through the spray nozzle, whereby the flow through said outlet is uninterrupted when said inlet is receiving said spraying materials under pressure;

said valve element having a clearance space within said valve chamber which is no greater than said given dimension and being displaceably mounted in said chamber without seals or packings.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 5,553,788

DATED : September 10, 1996

INVENTOR : Peter V. Del Gaone et al.

It is certified that errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2, at 37, "spaying" should be --spraying--;

Column 4, at 45, "shown" should be --showing--;

at 48, "parts" should be --ports--;

at 49, delete "as seen from the line 26-26" and insert --is an enlarged fragmentary view similar to Fig. 21,--;

Column 5, at 50, "stein" should be --stem--;

Column 6, at 15, after "from" insert --maximum forward flow--;

at 16, after "position" insert --at--;

Column 10, at 31 and 32, should read: --18A and 19A, the nozzle 480 has an axial bore 421 whose discharge end 484 is outwardly flared at an included angle of--.

Signed and Sealed this

Eighth Day of April, 1997

Attest:

BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks